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DERMATOGLYPHICS IN THE CHIMPANZEE: DESCRIPTION AND COMPARISON WITH MAN

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THIS account presents an analysis of dermatoglyphics in the chimpanzee (palms, soles, finger tips and middle and basal segments of the fingers), especially concerning morphology, individual variation and symmetry, and with particular reference to conditions in man.

A number of workers have contributed to the subject of comparative dermatoglyphics, notably Alix, 1867, 1868; Kollmann, 1883, 1885; Klaatsch, 1888; Hepburn, 1893, 1895; Wilder, 1897; Fere, 1900; Whipple, '04; Schlaginhaufen, '05; Kidd, '07; Bychowska, '30. The results of these comparative studies need not be reviewed in detail for the reason that we are concerned simply with morphology and variation under comparison with man and not with the place to be assigned the chimpanzee in a scheme of dermatoglyphic genealogy. It may be explained, further, that such considerations are deferred in view of work

[1] Prints of animals in the Yale colony were made by S. D. S. S., and H. C. is responsible for the observations and preparation of this account. To Doctor R. M. Yerkes the authors are deeply indebted for the privilege of obtaining and reporting on the material.

now in progress by Dr. Charles Midlo, in the Department of Anatomy, Louisiana State University Medical Center. Midlo, with the advantage of extensive material representing various primates, is undertaking a study which will provide more secure foundation for broad comparative treatment in that these highly variable features may be then characterized for a genus or species on the basis of numerous examples.

MATERIAL

The material with which this study was originally begun consists of the prints of 37 individuals in the Yale Laboratories of Primate

TABLE 1

Ridges per centimeter in 20 chimpanzees and in 20 human subjects having the same hand lengths (excepting the first case, where the measurement is 20.0 instead of 22.0 cm.)

WEIGHTS OF CHIMPANZEES (kg.)	HAND LENGTH (cm.)	RIDGES PER CENTIMETER	
		Chimpanzee	Human
57.8	22.0	18.2	15.9
26.0	20.5	22.5	17.5
34.4	20.0	23.3	17.8
32.9	17.5	28.4	19.4
24.2	17.3	29.2	18.7
24.0	16.8	27.2	20.8
16.8	16.2	31.0	17.8
21.1	16.0	34.4	18.5
19.1	16.0	34.7	20.5
26.4	15.7	26.5	18.7
20.6	14.4	33.0	20.2
10.8	14.3	30.7	22.5
12.6	14.2	33.9	22.8
10.7	14.0	32.2	20.4
9.5	14.0	34.5	20.9
9.3	14.0	29.8	24.9
10.5	13.8	31.0	22.9
11.1	13.5	28.3	27.5
6.7	12.8	32.2	25.0
7.8	11.7	33.5	26.5
AVERAGE	15.7	29.7	21.0

Biology. The inclusion in the series of both juveniles and adults (note the weights of twenty animals listed in Table 1) should be mentioned, not that age influences the dermatoglyphics otherwise than in reference to the size of epidermal ridges and thus of the designs formed by them, but because the young animals are the offspring of some of these adults. It is thus possible that inheritance of individual dermatoglyphic traits may cause some particular feature to appear more or less frequently than it would in a random collection. Females outnumber males in a proportion of about 2:1; with the limited material it is impossible to determine whether there are sexual differences comparable to those in man. The prints were made by the Faurot "inkless" method. In some of the larger animals, owing to their resistance, printing had to be accomplished at times when anesthesia was administered for another purpose. Single finger tips were printed on separate sheets, as well as being included in the prints of the whole hands, but separate toe prints were not made and the impressions of the toes carried by the whole foot prints are not sufficiently decipherable or complete to admit studies of these patterns.

Through the generosity of Doctor Midlo we are able to include the palms and soles of 20 additional chimpanzees, studied by him in the collections of Dr. A. H. Schultz, the American Museum of Natural History and the College of Physicians and Surgeons. Doctor Midlo's observations, made on preserved specimens, are recorded in drawings, which he has loaned with permission to make tracings from them for the purposes of the present study. We are deeply indebted to Doctor Midlo for this kindness, which doubles the material available for the statistics of variation on palms and soles.

With the inclusion of the Midlo collection, 57 animals are represented in the series of prints. Only 26 individuals, however, are included in the statistics on finger prints, 40 individuals in the data on palms and 32 for the soles, owing to incompleteness or illegibility of prints from some animals. While the series is unique in point of size, as material from a higher primate other than man, it is nevertheless small when considered as a sample of the highly variable dermatoglyphics. It must be kept constantly in mind, therefore, that the statistics can only indicate apparent trends in the frequencies of the various features, and this reservation is to be understood as applying in every reference to a numerical occurrence.

To facilitate study of palms and soles the interpretations of the prints (and of Midlo's drawings) were recorded within semi-diagrammatic outlines of the hand and foot, these being uniform in size and in orientation as direct views of right members. From this series a number are reproduced (Figs. 1-40), to illustrate representative individual variations.

MINUTIAE AND RIDGE TEXTURE

Chimpanzee and man exhibit like variations in detail of individual ridges. Ridges vary in length and are frequently reduced to "islands". A ridge may terminate in various ways, either ending independently or by junction at one or both ends with another ridge, etc. The variability of these minutiae, or Galton details, hardly can be reduced to quantitative terms for an exacting comparison, but from inspection it is evident that chimpanzee and man are on an equal footing at least with regard to the individuality of even a small area of the dermatoglyphics, an individuality dependent upon the occurrence of numerous details which are not duplicated in another area of either the same or a different subject.

Ridge texture or the degree of coarseness may be analyzed quantitatively, and here there is a difference, the chimpanzee having finer ridges. The determination has been made by counting ridges in an interval of 1 cm. The hypothenar area was selected as the most favorable region for orienting the lines of counting at right angles to the ridge courses. Counts were made on both hands of 20 animals, with three counts in each hand; the six counts for the individual were then averaged, and recorded with the weight and total hand length as measures of the size of the individual. Hand length could be determined only approximately, by measuring the greatest length of the print, from the tip of digit III to the proximal margin of the palm. From available study files twenty sets of human hand prints were selected, solely on the basis of obtaining individuals having hand lengths equal to those of the 20 chimpanzees. As in the chimpanzee, three counts were made on each hand, and the average of the six counts recorded.

Adults and juveniles are represented in both series, each chimpanzee being paired with a human individual of the same hand length. The number of ridges per centimeter averages 29.7 in the chimpanzee, 21.0 in the human material, and in every instance (Table 1) the count in the human individual is exceeded by that in the chimpanzee of the same

hand length. The chimpanzee ridges are thus shown to be finer, to a degree that admits the inclusion of 41 per cent more ridges in an interval of one centimeter. This difference is so large that it was at first thought possible that the use of total hand length as a criterion of hand size was at fault, but measurements on the same prints of palms alone agree closely in chimpanzee and man; the average total hand length is 15.7 cm., while the palmar lengths average 8.3 cm. in the chimpanzee, and in the human series, 8.5 cm.

It is obvious, considering the disparity between the hand-size/body-size ratios of chimpanzee and man, that a comparison of ridge texture based on body size instead of hand length would yield a quite different result. Regional variability in ridge texture is observed both in chimpanzee and man, and while inspection denotes that ridges are throughout finer in the chimpanzee the magnitude of difference in other areas may not correspond to that observed in the hypothenar region. Individual variability in ridge texture, comparing homologous areas, is familiar in man. Even the limited material available for the chimpanzee suggests the existence of such variability in this form. While in the descending sequence of hand lengths there is the expected general increase in the number of ridges per centimeter, irregularities in the series and discrepancies in the counts of individuals of the same hand lengths point to individual differences in ridge texture.

FINGER TIPS

Finger-print sets, with impressions of the ten digits, are available from 37 individuals of the Yale colony, but the material finally used in the study includes only 26 sets, the remainder having to be discarded on account of inadequate rolling in printing. It is hardly necessary to point out that full rolling is accomplished with greater difficulty with the chimpanzee as subject than with a cooperative human being, though it is perhaps even more essential in view of the larger expanse of many whorls over the digital margins. The arch-loop-whorl classification is employed; originally devised in reference to human finger prints, it is equally applicable to the chimpanzee, which presents the same primary classes of patterns and their chief subdivisions:

Arches, both the simple variety having no triradius (symbol, A) and the form tented over a triradius (T);

Loops, opening either ulnarwards (U) or radialwards (R);

Whorls (W), including all patterns having two or more triradii, for which a special subclassification is described below.

TABLE 2.

Frequencies of finger-tip patterns in 26 individuals

(Percentile frequencies in the column of "all digits" and absolute numbers in other columns.) The lower section of the table lists the separate frequencies of the various pattern types which in the upper section are classed together as "whorls", W.

PATTERN TYPE	ALL DIGITS			I		II		III		IV		V	
	R(%)	L(%)	Both(%)	R	L	R	L	R	L	R	L	R	L
T	0.8	2.3	1.5	..	..	..	..	..	1	..	..	1	2
U	36.9	43.1	40.0	..	..	10	14	12	15	12	14	14	13
R	11.5	6.2	8.8	14	7	1	..	..	1	..	..	..	..
W	50.8	48.5	49.6	12	19	15	12	14	9	14	12	11	11
W CLASSES:													
Concentric	15.4	20.8	18.1	9	18	7	2	1	2	..	1	3	4
D/R	3.1	1.5	2.3	3	..	..	1	1	..	..	1	..	..
R/D	...	1.5	0.8	..	1	..	..	..	1	..	..	..	..
D/U	5.4	10.0	7.7	..	..	..	..	..	..	3	8	4	5
U/D	18.5	12.3	15.4	..	..	7	9	9	4	4	1	4	2
T/D	0.8	0.8	0.8	..	..	..	..	1	1	..	..	..	..
D/T	2.3	...	1.2	..	..	..	..	..	..	3	..	..	..
D/U/D	5.4	0.8	3.1	..	..	1	..	2	1	4	..	..	..
D/T/D	...	0.8	0.4	..	..	..	..	..	..	..	1	..	..

Frequencies of the pattern types are listed in Table 2.

Arches. Among the 26 individuals having completely classifiable sets of prints there are but 4 arches, of the tented variety without exception; the frequency is thus 1.5 per cent of all patterns. While these four examples are tented, simple arches do occur in the chimpanzee, as instanced by a case in the Midlo series, where digit V of each hand bears a simple arch (the formulae being: right, R U U T A; left, ? U U U A).

Three of the 4 tented arches occurring in the reported collection are on digit V, and in the Midlo example the same digit bears simple arches, with a tented arch on digit IV of the right hand. In man it is digits II and III which lead in the frequency of arches, while the present finding indicates that in the chimpanzee arches are concentrated on the ulnar side of the anatomical axis rather than on the radial side. Significantly enough, there is a very marked concentration of arches on digit V of the human foot (Hasebe, '18; Takeya, '33; M. T. Newman, '36). In this respect, therefore, the distribution of arches in the chimpanzee fingers corresponds in tendency to that on human toes.

In man, where racial differences in frequency of the several pattern types are well recognized, it is generally true that arches diminish in frequency as whorls increase in abundance. And while a figure based upon so few as 26 individuals obviously is far from providing a stable indication of their frequencies, it may be of interest to draw comparisons in a list of racial collections (Table 3). The chimpanzee fits into

TABLE 3

A comparison of the percentile frequencies of arches and whorls in the chimpanzee and several groups of man

	WHORLS	ARCHES
Efé pygmies (Dankmeijer)	19.6	16.2
Dutch (Dankmeijer)	25.9	7.9
Germans (Heindl)	30.8	4.1
Japanese (Furuse)	45.2	2.6
Chimpanzee	49.6	1.5
Greenland Eskimo (Abel)	72.2	0.8

the order of inverse frequencies, and thus it appears that there may exist a general law of interrelationship between these patterns which is not confined to man.

Loops. Loop patterns in the chimpanzee are occasionally markedly erect and with emerging ridges in the proximal region flexed almost squarely against the upright main pattern, to give the configuration the appearance of a "figura tensa", as such forms are known by Schlaginhaufen and others. But figurae tensae occasionally occur in man, and but few chimpanzee loops are of this specific configuration.

The frequency and distribution of ulnar loops call for but little separate mention, since the distinctive frequencies of other patterns involve ulnar loops as a correlate. It will be noticed, for instance, that no ulnar loops occur on digit I, where there is a singular frequency of radial loops at the expense of the ulnar form which is common on the human thumb, varying in different races but ranging from about one-third to more than one-half of all patterns on this digit. Likewise on the human great toe there are abundant fibular loops, the equivalent of ulnar loops on digits of the hand.

Radial loops exhibit a high total frequency, 8.8 per cent, or an occurrence of 23 instances among the 260 patterns. It is significant that all but two of these radial loops are on digit I, where the frequency is 40 per cent of all patterns of this digit. This is distinctly unlike the human incidence, both in the greater number of radial loops and in their massing on digit I instead of digit II. In the human great toe tibial loops, the equivalent of radial loops of the hand, are much less frequent than in chimpanzee, but among the toes such patterns are largely concentrated on this digit. Another interesting comparison may be drawn with regard to bilateral asymmetry in the chimpanzee thumb and human great toe. As shown in Table 2, right thumbs bear twice as many radial loops as lefts, and in the human great toe (Takeya) there is a quantitatively similar bilateral inequality, but with the left side carrying the excess.

Whorls. Whorls form a more heterogeneous group than either arches or loops. Patterns classified as whorls present diverse configurations, many of them quite unlike the characteristic more or less circular figure in which the ridges form successive rings or are wound spirally, the whole bounded by radiants of the two associated triradii. Such extremes as the "twin loops", "lateral pocket loops" and "acci-

dentals" of conventional terminology fall into the broad class of whorls. It is therefore desirable in the present study to indicate separately the frequencies of the varied configurations which are grouped under the one heading prescribed by the rules of the main classification, and by preference substituting morphologically descriptive designations for the names usually applied to these varieties. To cite an illustration of the gain thus afforded reference may be made to the fact that a considerable proportion of the "whorls" in the material comprises "lateral pocket loops"; these are patterns formed of two loops, and ridge tracings from their cores reach the same margin of the digit, radial or ulnar. The placement of the loops remains unnoted if the pattern is merely designated a lateral pocket loop. Here we have chosen to combine the usual symbols for single patterns in description of such duplex and triplex configurations (but adding a "D" for a loop of which the open extremity is first directed distally). Setting down the symbols always with the more radial element first, lateral pocket loops thus appear in four varieties: U/D, D/U, R/D, D/R. With this explanation the remaining duplex and triplex symbols (Table 2) should be clear, since the same principle holds; the characteristic whorls are set aside as concentric whorls.

Whorls occur with a frequency of 50 per cent, and slightly more than one-third of them are of the elliptical concentric variety. The remainder are scattered, as shown in Table 2, among the various combinations of loops and tented arches, of which nearly one-third are of the U/D form. The characteristic signalized in the term "Simiadentypus" prevails in all the concentric whorls, and since the abundance of lateral pocket loops and like configurations is already recognized, the present results merely add records of actual frequency.

Comparing the whorl frequency with man, it can not be said that the total occurrence of whorls differs, for the reason that in some races similar or even larger frequencies are encountered. Between the extremes of about 20 per cent and 72 per cent, reported for the Efé pygmies of Central Africa and Greenland Eskimos respectively, there are many groups (among them Chinese, Japanese, certain groups of Eskimos and some Indian peoples of the western hemisphere) having essentially the same abundance of whorls.

It has been long known that in man whorls are especially massed on digits I and IV, next abundant on digit II and with a minimum frequency on digit V. In Table 4 figures are presented which show this

TABLE 4

Percentile frequencies (in round numbers) of whorls on individual digits, comparing the chimpanzee hand with the human hand and foot

(The total frequencies of whorls are inserted in parentheses, following the names of the groups.)

Eskimo, Abel	I	IV	II	III	V
(72)	90	87	68	60	56
Chimpanzee	I	II	IV	III	V
(50)	60	52	50	44	42
Eskimo, Midlo and Cummins	I	IV	II	III	V
(47)	63	62	45	37	25
Comanche, Cummins and Goldstein	IV	I	II	III	V
(43)	69	61	42	28	17
Indians of Cautin, S.A., Henckel	I	IV	II	III	V
(37)	60	57	33	23	12
Norwegians, Bonnevie	IV	I	II	III	V
(26)	37	35	29	16	11
Efé pygmies, Dankmeijer	I	IV	II	V	III
(20)	33	23	21	12	9
Chinese *toes*, Takeya	III	II	IV	I	V
(21)	58	19	18	8	1

expression in several racial collections, for comparison with the chimpanzee. It will be noted that the chimpanzee conforms to this general distribution, but that the five digits present less difference in their individual frequencies than is typically the case in man. If, as is quite generally held, whorls are the primitive form of apical configuration, the chimpanzee is no more primitive in terms of total whorl frequencies than some races of mankind. But if we may assume the correlate of an original primitive state, namely the equivalence of all the digits in their possession of whorls, then the chimpanzee does exhibit a greater primitiveness, evidenced in a more even distribution of whorls among the digits. Abel's Greenland Eskimos, however, approach the chimpanzee so very closely in reference to reduced differences of the separate digital whorl frequencies as to call for a limitation of this statement, to make clear that the chimpanzee only differs from the prevailing characteristic

in man. The point may be enforced by citing the quantitative difference between the digit bearing the least frequency of whorls (V) and that having the most (I or IV, variably), expressed as a percentile relation between the two: Henckel's South-American Indians, 20; Comanche, 25; Efé pygmies, 27; Norwegians, 30; Eskimos of St. Lawrence Island, 40; Eskimos of Greenland, 62; Chimpanzee, 70. It will be evident that while the chimpanzee is in a distinctive position in this list the small number of individuals renders it necessary to keep in mind that the series may not be significantly different from the Greenland Eskimo. And it may be well, further, to examine the differences obtaining between successive digital frequencies in the descending scale. The five digits resolve four such comparisons: the relative frequencies of the two first ranking digits, the second and third, the third and fourth, and the fourth and fifth. It is convenient to express the comparisons in terms of percentages, the smaller in reference to the larger being chosen

TABLE 5

Differences in whorl frequencies of the descending sequences listed in Table 4, expressed as the percentile relation between the digit second in the sequence to the first, the third to the second, etc.

					AVERAGE
Indians of Cautin, S.A. (Henckel)	95	58	70	52	69
Comanche (Cummins and Goldstein)	88	69	67	61	71
Efé pygmies (Dankmeijer)	70	91	57	75	73
Norwegians (Bonnevie)	95	83	55	69	76
Eskimo (Midlo and Cummins)	98	73	82	68	80
Eskimo (Abel)	97	78	88	93	89
Chimpanzee	87	96	88	95	91
Average, excluding chimpanzee	91	75	70	70	76

for the comparisons listed in Table 5. The differences of successive digital frequencies in the chimpanzee are fairly even in the four comparisons, and it will be noted that the average difference, embodying all four digital couplets compared, is equal to the minimum difference, obtained in all the human material combined, of the two digits having most abundant whorls (I and IV). In human digits the maximum differences in whorl frequency are found in the comparisons involving digits II, III and V, where the whorl frequency is lower. Except for the greater difference between digits II and V in the Greenland Eskimo, that collection agrees with whorl distributions in the chimpanzee.

Monomorphic hands. Volotzkoy ('36) emphasizes the genetic significance of what he calls "monomorphic hands", hands with patterns of the same type on all five digits. Pointing out that the occurrence of such hands is about 25 per cent in the various human populations which have been investigated, Volotzkoy argues that the incidence is much higher than would be expected if the patterns on individual digits were determined by different genes, independent of one another. This view adds interest to the findings in the chimpanzee, which as shown below displays an equal frequency of monomorphic hands.

Monomorphic hands are those in which all five digits bear arches, or loops (combining ulnars and radials) or whorls. Fourteen of the 52 hands in this chimpanzee series, or 26.9 per cent, are monomorphic. That this occurrence is equivalent to the human is shown in the following figures from racial collections: Indians of Cautin, S. A. (Henckel), 21.0; Koreans (Miyake), 22.4; Chileans, Concepcion, S. A. (Henckel), 23.1; Germans (Kirchmair), 28.7; Dutch (Dankmeijer), 33.3; Hottentots (Fleischhacker), 33.4.

It may be added that the general tendency in the human groups, though departed from by the Koreans reported by Miyake, is for hands having five loops to be far in excess of those with five whorls. In the chimpanzee the two combinations are of equal frequency, while in the Koreans they are respectively 10.5 per cent and 11.9 per cent of all hands. Finally, it may be noted that about four-fifths of the monomorphic hands in the chimpanzee series (11 of the 14) are right hands.

Tables 6 and 7 record the pattern distributions, separately for right and left hands and with the two hands combined. These records take the form of the manuars devised by Poll ('31).

TABLE 6

Unimanuars showing the finger-tip pattern combinations separately for right and left hands in 26 chimpanzees

(Absolute numbers.)

	RIGHT							LEFT						
	0	1	2	3	4	5	Whorls	0	1	2	3	4	5	Whorls
0	6	3	2	2	7	5		1	7	3	6	5	2	
1	1							1						
2										1				
ARCHES								ARCHES						

TABLE 7

A bimanuar showing the finger-tip pattern combinations in 26 chimpanzees

(Absolute numbers.)

	0	1	2	3	4	5	6	7	8	9	10	WHORLS
0	1	3	3	1	2	1	1	5	4	1	2	
1												
2	1	1										
ARCHES												

Pattern size. The importance attached to pattern size ("quantitative value") in various biological studies of human finger prints suggests that the determinations should be made in the chimpanzee. Pattern size is measured by ridge counting, the counts being made according to

methods established in finger-print identification. Such counts obviously are not indicators of the actual expanse of a pattern nor are they free from artificial elements which vitiate even their intended application as a measure of the defined interval — the distance, in terms of ridge number, between delta and core of a pattern. They are serviceable, however, as an approximate measure of pattern size, and as such they supply an additional item of comparison in chimpanzee and man. In man the different varieties of patterns vary in their average ridge counts; whorls exceed loops, and ulnar loops tend to be larger than radials (Cummins and Steggerda, '35; '36). For the present purpose it is therefore important to compare the same varieties of patterns in chimpanzee and man. The abundance in the chimpanzee of lateral pockets and similar figures among patterns classed as whorls, which introduce obvious difficulties in counting and uncertainties of homology, indicate that the comparison should be confined to loops, considering the ulnar and radial varieties separately.

In the chimpanzee material there are 89 ulnar loops adequately printed for ridge counting; the distribution of their counts is given in Table 8. The mean ridge count in these 89 loops is 11.4. It is evident that their size is not different from that of ulnar loops in man; among 735 ulnar loops in a series of Dutch (Cummins and Steggerda) the

TABLE 8

The distribution of the ridge counts of 89 ulnar loops
(Digit II, 20; Digit III, 22; Digit IV, 26; Digit V, 21)

RIDGE COUNTS *(Class centers)*	FREQUENCY *(Per cent)*
4	12.4
7	22.5
10	31.5
13	6.7
16	10.1
19	6.7
22	3.4
25	4.5
28	1.1
31	1.1

mean count is 11.99, and in 724 ulnar loops of the same authors' series of Maya Indians the mean is 9.86. While the chimpanzee series is too small to admit stable comparisons of the separate digits it may be noted that digit II bears larger loops than the other digits. As a matter of record the average counts of ulnar loops on the individual digits are listed, together with the number of patterns counted: Digit I lacks ulnar loops; Digit II, 20 counted, average 16.7 ridges; Digit III, 22 counted, average 9.5 ridges; Digit IV, 26 counted, average 10.2 ridges; Digit V, 21 counted, average 10.0 ridges.

There are but 23 radial loops in the entire material, and though the number well-printed for ridge counting is still smaller the observations are at least suggestive. In 14 radial loops (all on digit I) the average ridge count is 15.9, indicating that radial loops in the chimpanzee tend to be larger than ulnar loops collectively, which as noted above average 11.4 ridges in the combined digits II-V. Such a relation is the reverse of that in man, where radial loops average smaller than ulnars. The discrepancy may be explained as a digital distinction rather than as a peculiarity associated with pattern type. Radial loops in man are characteristic of digit II, while in the chimpanzee they are almost confined to digit I. It is indicated, moreover, that ulnar loops in the chimpanzee are themselves subject to variations in size which depend upon digital distribution. Recalling that ulnar loops of digit II average 16.7 ridges, as compared with about 10 ridges on digits III-V, the important point seems to be not a comparison of ridge counts of radial and ulnar loops but a comparison of pattern size on different digits. It may be concluded that loops (considering both ulnars and radials) average, as do ulnar loops in man, larger on digits I and II than on the remaining digits.

Pattern form. Bonnevie ('24), the first to emphasize the importance of pattern form (expressed as an index giving the ratio of breadth to height), devised a measurement for its determination. Bonnevie has since modified her original procedure in the measurement of breadth and height, while Cummins and Steggerda employ another method and Geipel ('35; '37) proposes a still different practice. Relatively little work has been done with pattern form, however, and in the present discussion of the chimpanzee comparisons are drawn only with that material (Dutch and Maya) which had been determined by the method of Cummins and Steggerda, the chimpanzee prints having been analyzed

in the same way. In the published accounts presenting the results on Dutch and Maya the mean pattern-form indices are noted for each pattern type and for each digit, but in the digital averages all pattern types are combined, as are all digits in the averages for each pattern type. For the comparisons now to be made it was necessary to make new compilations from the original work sheets of the ulnar loops on each digit, so as to exclude digit I.

Since the several pattern types present distinctive trends in form, just as they do in size, it is necessary to consider them separately. It is also true that in man there are varying trends of pattern form on the different digits, hence the digits must be analyzed singly. In the chimpanzee material there is an insufficient number of whorls so printed that the tracings necessary for measurement of pattern form may be accurately made, and the number of radial loops is likewise small. There are available 108 ulnar loops providing the following information as to form of this one variety of pattern.

TABLE 9

The distribution of pattern-form indices in 108 ulnar loops
(Digit II, 23; Digit III, 28; Digit IV, 31; Digit V, 26)

INDICES	FREQUENCY *(Per cent)*
-12	1.9
13-27	13.9
28-42	36.1
43-57	25.9
58-72	11.1
73-87	9.3
88-102	1.9
MEAN, 45.0	

The mean pattern-form index of these 108 ulnar loops is 45.0, and exactly 50 per cent of the patterns lie within the range of indices 13-42 (Table 9). Patterns within this range may be described as narrow. The chimpanzee presents a greater frequency of narrow patterns than either the Dutch or Maya series, as shown by the data listed in Table

TABLE 10

A comparison of the average pattern-form indices of ulnar loops in the chimpanzee and in two collections of human material

(Numbers of digits in parentheses.)

	CHIMPANZEE	MAYA	DUTCH
Digit I	.....	83.8 (88)	81.0 (156)
Digit II	52.4 (23)	73.2 (104)	59.6 (77)
Digit III	42.2 (28)	56.1 (195)	52.9 (152)
Digit IV	42.6 (31)	54.3 (121)	58.5 (152)
Digit V	44.2 (26)	56.7 (216)	57.3 (198)
Average: Digits II-V	45.4	60.1*	57.1*

* Excluding digit I.

10, even with the characteristically broad patterns of the human digit I excluded from the comparison as they must be on account of the lack of representation of ulnar loops on this digit in the chimpanzee. From inspection alone there is a suggestion, on the other hand, that both whorls and radial loops tend to be broader in the chimpanzee. The greater breadth of radial loops, however, may reflect their almost strict limitation to digit I, where in man there is a tendency to broad patterns. In the data of Table 10 the distinction of ulnar loops on this digit in the Maya and Dutch series is evident. It will be recalled that radial loops in man occur especially on digit II, rather than on digit I as in the chimpanzee.

Symmetry. There are various approaches to the analysis of symmetry in finger prints, and that which may first suggest itself as the simplest is examination of total frequencies of pattern types. Since whorls are the most common pattern it should be the most useful in this limited series. In the massed statistics (Table 2) this pattern displays an excess in right hands, conforming to the general characteristic of man. Examining the separate digits, it will be noticed that digit I shows a reverse of this relationship. The significance of the reversal may be questionable in so small a series, yet instances of atypical asym-

metries of the same nature are not unknown in man (e.g., in Koreans as a sexual distinction, Kubo, '18).

Inquiry may next be made into a measure of symmetry obtained in the number of couplets of homologous digits on right and left hands which bear like patterns. The definition of "like patterns" in this application is broad, patterns being so termed if they fall into the same main class. Radial and ulnar loops are not distinguished, nor are the various types of whorls; patterns are accordingly registered as "like" if both are arches, if both are loops of either class, or if both are whorls of any variety.

These determinations for the chimpanzee are entered in Table 11, together with records from three human collections for comparison.

TABLE 11

Percentile frequencies of individuals, grouped according to the number of couplets of homologous digits on right and left hands with like patterns

	NUMBER OF DIGITAL COUPLETS WITH LIKE PATTERNS					
	0	1	2	3	4	5
Chimpanzee	0.0	3.8	11.5	26.9	30.8	26.9
Indians, Cautin (Henckel)	0.0	0.8	8.9	23.2	37.4	29.7
Chileans, Concepcion (Henckel)	0.1	1.1	7.5	22.5	40.4	28.5
Germans (Gruneberg)	0.3	3.6	9.9	24.1	33.8	28.1

As shown there, the chimpanzee conforms to man in having a modal complement of patterns in which four couplets of homologous digits have like patterns, the actual figures for this and other combinations being very close to the frequencies reported in man. From these data it appears that there is no distinction of symmetry in the chimpanzee.

Symmetry may be analyzed, in extension of the preceding consideration of pairs of hands, by determinations of the homologous digital couplets singly. A record of the like and unlike pattern combinations, with the main classes of patterns distinguished, is supplied in Table 12. In the chimpanzee 72 per cent of the homologous digital couplets have

TABLE 12

Symmetry (occurrence of same or different patterns on corresponding digits of right and left hands — absolute numbers)

	I	II	III	IV	V
UU	..	9	10	9	9
RR	7	..	..	..	..
WW	12	11	9	9	7
TT	..	..	..	..	1
TOTAL, LIKE PATTERNS...	19	20	19	18	17
UW	..	5	5	8	8
RW	7	..	..	..	..
RU	..	1	1	..	..
UT	..	..	1	..	1
TOTAL, UNLIKE PATTERNS	7	6	7	8	9

like patterns. This is the exact occurrence reported by Bonnevie in a series of Norwegians, and is but negligibly smaller than the figure reported for Germans by Gruneberg ('28) and for Chileans as reported by Henckel. There is a hint that digit II in the chimpanzee may display more symmetry than in the Norwegian material (77 per cent of the digit II couplets being symmetrical, as against 51 per cent in Norwegians) while digit V in the chimpanzee may be less symmetrical (65 per cent versus 88 per cent respectively). The other three digital couplets (I, III and IV) agree, the unlikenesses in II and V balancing so that the averages correspond in the chimpanzee and Norwegian series. Whether this suggestion of a difference in II and V is valid obviously can not be ascertained in a collection numbering 26 individuals, but the recognized peculiarities of digit II in man emphasize the point as deserving of special effort to secure enlarged chimpanzee materials for adequate statistical confirmation or disproof of the suggestion here noted

PROXIMAL AND MIDDLE PHALANGES

The important publication of Ploetz-Radmann ('37) supplies for the first time a detailed analysis of the dermatoglyphics on the proximal and middle phalanges of the human hand. Earlier references, such as

that of Whipple, deal only with the generalized slant of the configurations in these regions in man and other primates, or with casual mention of the occurrence of definite patterns on the basal and middle segments. Ploetz-Radmann has devised a descriptive classification of the diverse configurations, and applies it to a survey of their frequencies on the individual digits, their segments separately and in combination, bimanual comparisons and comparisons of the sexes. In view of the relatively scanty chimpanzee material so elaborate a treatment is not justified, but the few prints which proved to be serviceable for the determinations are analyzed by the same method and the results are compared with Ploetz-Radmann's statistics on human digits.

Prints of 23 hands are adequately printed for a determination of the prevailing slants of ridges on the basal and middle segments. As shown in Table 13, there is a universal trait of two opposing slant

TABLE 13

The predominating slants of the configurations on the basal and middle segments of the digits, 23 hands

RADIAL	MIXED	ULNAR	NUMBER OF HANDS
I	II	III, IV, V	1
I	II, III	IV, V	1
I, II	.....	III, IV, V	4
I, II	III	IV, V	4
I, II, III	.....	IV, V	11
I, II, III,	IV	V	1
I, II, III, IV	.....	V	1

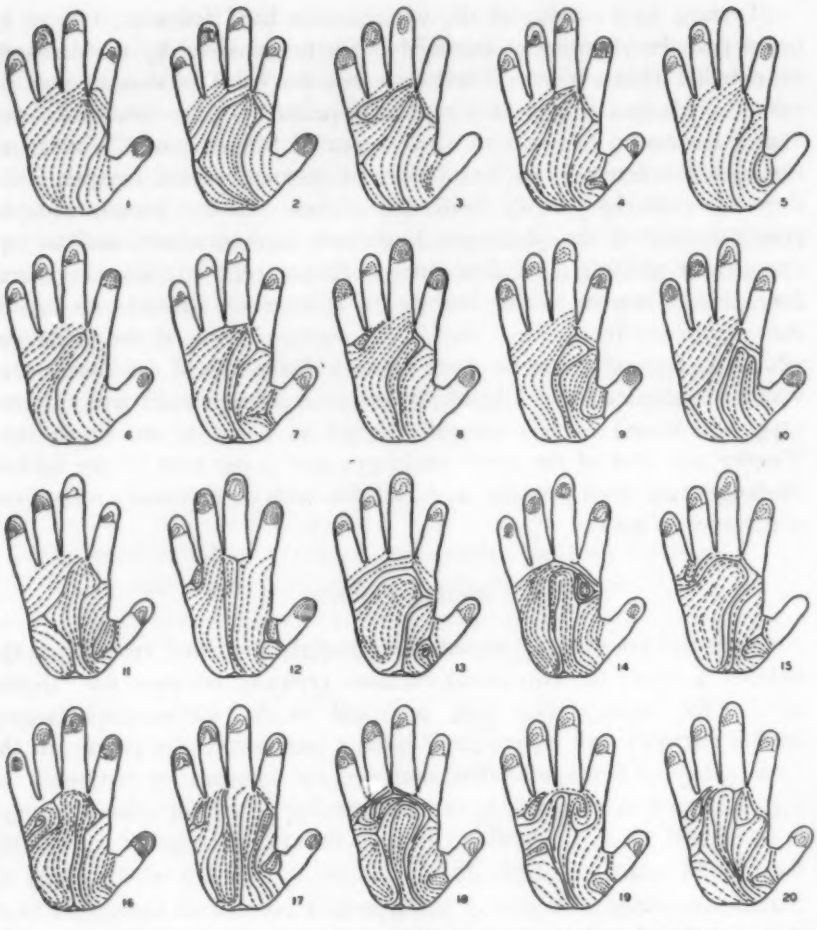
systems. The proximal slant of digit I is invariably toward the radial margin, and the slant of digit V is without exception in the opposite direction; it is digits II, III and IV which are variable, presenting either a generalized radial or ulnar slant or inclinations here entered as "mixed" (definitely opposing slants on the two segments or generally transverse configurations). As in man, the most common distribution is one in which digits I, II and III display the radial slant, with digits IV and V having an ulnar slant. Departures from this modal configuration chiefly involve digits III and IV, indicating a focus of variability centered about the anatomical axis of the hand.

Turning to a catalog of the variations in local features, it must be noted that the chimpanzee material is further reduced by the demands of detailed observation. There are but 80 basal phalanges and 65 middle phalanges (digits II-V) suitably printed for the determinations. Ploetz-Radmann defines four chief types of "fundamental" configurations, all characterized by the absence of distinctive local irregularities; they are collectively open fields and arches. In her human material 79.9 per cent of the phalanges bear such configurations, and in 145 chimpanzee phalanges the frequency is 82 per cent. It appears, therefore, that in respect to this feature the chimpanzee presents no significant difference from man. But in the configurations of the phalanges which are figured otherwise there exists a distinction of the chimpanzee which is undoubtedly significant, the frequent occurrence of true patterns (typically loops) usually as well formed as those on the finger tips. Twenty per cent of the basal phalanges and 9 per cent of the middle phalanges bear such patterns, as contrasted with an extremely infrequent occurrence in man.

DIGITAL TRIRADII

A digital triradius is seated in immediate proximal relation to the base of a digit; the two distal radiants typically embrace the "digital area" (the configuration just proximal to the metacarpophalangeal flexion furrow) and its proximal radiant passes into the palm. In the terminology of Schlaginhaufen, designed for comparative purposes, the digital triradii are termed, in order beginning with that related to digit I, as triradii 13, 2, 3, 4 and 5. In man the current practice emphasizes the triradii related to digits II-V not only on account of the rarity of triradii associated with digit I but especially because of the origin from them of the descriptively important palmar main lines, and they are designated in respective order as triradii a, b, c and d.

Two difficulties arise in studies of digital triradii. There is need to have unquestionably complete impressions of the distal border of the palm, and in the chimpanzee printing of this region is accomplished only with difficulty. While it is possible that an occasional digital triradius of the 40 hands in the Yale series may have escaped printing it is believed that such faults have not seriously vitiated the occurrences now to be reported; the Midlo material consists of an equal number of hands and is recorded as drawings from the actual specimens; here the



FIGS. 1-20. INTERPRETATIONS OF TWENTY CHIMPANZEE PALMS, SO SELECTED FROM A SERIES OF EIGHTY AS TO EMBRACE THE RANGE OF REPRESENTATIVE VARIATIONS

Both right and left hands are included, but for convenience of comparison all are drawn as direct views of right members (or prints of lefts) and all are reduced to the same scale.

frequencies check very closely with those obtained from prints. A second difficulty involves the recognition of a digital triradius as distinguished from one of the interdigital variety. In the present statistics triradii which are open to interpretation as interdigital triradii are excluded, separate attention being given them in the following section.

TABLE 14

Percentile frequencies of digital triradii in 80 hands

(40 rights and 40 lefts with the exception of digital triradius I, where only 39 of each admit the determination.)

	TRIRADII		RIGHT	LEFT	BOTH
Digits	Schlaginhaufen	Wilder			
I	13	..	48.7	71.8	60.3
II	2	a	75.0	80.0	77.5
III	3	b	27.5	32.5	30.0
IV	4	c	22.5	25.0	23.8
V	5	d	67.5	55.0	61.3

In Table 14 the frequencies of digital triradii are listed. The occurrences are so distinctive that there is no point in citing figures from human material for comparison. The presence of a digital triradius in relation to the thumb, found here in 60 per cent of the hands, is in sharp contrast to their rare occurrence in man. It is suggested that the distinction of the chimpanzee may be associated both with the unlike insertion of the thumb and with the different nature of the thenar and first interdigital pads; even in those races (e.g., Maya) which have thenar and first interdigital patterns approaching the frequency found in the chimpanzee it is seldom that characteristic digital triradii appear in association with the patterns. Frequencies of the remaining digital triradii are again widely different from those in the human hand, but they differ in being reduced rather than increased. In man any one of the digital triradii may fail, but except for that associated with digit IV (triradius c) such instances are almost negligible; triradius c is more frequently absent or reduced, but in a proportion far below that obtaining in the chimpanzee. It is of interest to note that the minimum occurrence of digital triradii involves the same anatomical axis in man and chimpanzee, and that in the latter digital triradius b also shares in the peak of reduction. The zygodactyly of digits III and IV, insofar as this dermatoglyphic expression is concerned, is thus in the chimpanzee more evidenced than in man.

INTERDIGITAL TRIRADII

Unlike the digital triradii, which are located near the palmar margin in line with the bases of digits, interdigital triradii are interdigital in position. Lying at the border of the palm, an interdigital triradius is so oriented as to have one radiant directed distally, usually entering the interdigital interval, while the other two radiants extend radialwards and ulnarwards or proximally on the palm. It is quite likely that some interdigital triradii are entitled to recognition as displaced digital triradii (see I. W. Wilder, '30), but it seems best to adhere to the strictly descriptive definition since it is impossible to make sure of the morphological identities except in such cases as those which present interdigital triradii in company with digital triradii (e.g., Figs. 14, 18) or in which the digital triradii are so slightly shifted that their identities remain clear. In presenting statistics on the interdigital triradii the reservation must be made that the actual frequencies may be somewhat higher. An interdigital triradius may be so situated on an interdigital web as readily to escape printing, but as in the case of digital triradii the frequencies noted in the prints of 40 hands of the Yale series agree closely with those in the Midlo drawings made directly from the actual hands.

Interdigital triradii in the human hand are extremely rare, even in relation to interval 3 where they reach maximum frequency. In the chimpanzee interdigital triradii are much more common, and it will be noted (Table 15) that interval 2 presents the maximum frequency, with intervals 3 and 4 in descending order.

The unlikenesses between chimpanzee and man may be explained, from the standpoint of the ontogeny of dermatoglyphics, in part by the

TABLE 15

Percentile frequencies of interdigital triradii in 80 hands

(40 rights and 40 lefts, with the exception that only 39 right hands are available for the determination of interval 2.)

	RIGHT	LEFT	BOTH
In interval 2	28.2	30.0	29.1
In interval 3	15.0	17.5	16.3
In interval 4	10.0	2.5	6.3

fact that the conformations of the distal palmar margins are rendered quite dissimilar by the presence of webbing in the chimpanzee (cf. Cummins and Sicomo, '23, on dermatoglyphics of syndactyl toes in man). Midlo ('34) states: "In the chimpanzee, short interdigital webs occur between digits III to V, whereas between digits II and III no noteworthy webbing is present". But this factor, if responsible at all, is at least not the sole source of the dissimilarity of the interdigital triradii in relation to interval 2. The presence in the chimpanzee of large second interdigital patterns, closely neighboring the second interdigital interval, suggests that the pattern-conditioning pad may also influence the production of the triradius. The topographic relations of second interdigital patterns and triradii related to the second interdigital interval support this suggestion, and it may be pointed out that these patterns are frequent in the chimpanzee, while in man second interdigital patterns are not only very rare but of quite different configuration and relation to the interdigital interval. Though there is no means of establishing a scale by which interdigital triradii may be evaluated in terms of the developmental factors producing them, it is nevertheless clear that not all these triradii are of the same order. If it were feasible to apply such a scale possibly a large share of the interdigital triradii of the second interval in the chimpanzee would be excluded from comparison with man. As a result, the maximum frequency of interdigital triradii, considering only those which are ontogenetically comparable, might then be shifted to the third interval where it lies in man.

AXIAL TRIRADII

Situated near the proximal margin of the palm, between the hypothenar and thenar configurations, there frequently occurs a triradius which has been variously named: Schlaginhaufen, triradius 1; Wilder, carpal triradius; Cummins *et al.* ('29), axial triradius (when very low in position symbolized in formulation, t, or when slightly higher, t′, as distinguished from those lying more or less centrally in the palm, t″). The incidence of this triradius, the character of the configuration which appears in its absence, and the indications of general ridge alignment which it offers are to be examined.

Of 78 hands, rights and lefts in equal numbers, 33 (42.3 per cent) present this triradius, always in the low position formulated as t. The occurrence is significantly less than in man. In the racial collections which embody statistics on this feature it is shown to be an almost

universal characteristic of the proximal palmar region. It is at least twice as common as in the chimpanzee and in some racial groups is reported as invariably present; reference may be made to Steggerda, Steggerda and Lane ('36) for comparative figures.

Right and left hands show unlike frequencies of the triradius, 51.3 per cent and 33.3 per cent respectively. Whether there is meaning in this difference is not clear; the material is small, and in human hands there apparently are no consistent bimanual distinctions in frequency.

When the triradius is absent, as it is in over half the chimpanzee hands, the configuration of the whole proximal area of the palm flows in a gentle curve toward the radial margin. Configurations of this type are rare in man.

As first emphasized by Keith ('24), a tracing from the distal radiant of the axial triradius is useful as an indicator of the generalized alignment of the palmar configuration, thus supplementing the service in this connection of the palmar main lines. Inasmuch as a prevailing longitudinal alignment distinguishes the chimpanzee hand from the human, which has a tendency toward more transverse ridge courses, it will be profitable to record alignment with this descriptive aid.

The procedure is to formulate the termination reached by the traced line (which is termed line T), using the number symbols employed in formulating main lines: 13, first interdigital interval; 12, digital triradius a; 11, second interval; 9, third interval. Of the 33 tracings, one becomes involved in the hypothenar configuration and is accordingly

TABLE 16

Percentile frequencies of the terminations of line T (the distal radiant of the axial triradius) in 32 chimpanzee hands

(20 rights and 12 lefts), compared with Mexican Indians

	CHIMPANZEE			INDIANS (LECHE)		
	R	L	Both	R	L	Both
9	5.0	16.7	9.4	...	...	...
11	80.0	75.0	78.1	...	15.4	7.7
12	...	...	...	1.3	9.0	5.1
13	15.0	8.3	12.5	98.7	75.6	87.2

not included in the summary. Nine tracings extend into the distal extremities of second interdigital patterns, and one similarly enters a third interdigital pattern. Though these tracings fail to reach the numbered positions of the conventional formulation, the intervals towards which they are directed (11 and 9 respectively) are entered in the tabulation of the terminations. In Table 16 the results are listed, together with comparative data from Leche ('36) on a series of 78 Mexican Indians (Aztecas). Terminations in positions 9 and 11 are associated with longitudinal ridge courses, while entrance into position 13 indicates that the tracing swerves radially as an accompaniment to transversely aligned ridges in the distal palmar area. The sharp contrast between chimpanzee and man is clearly demonstrated by the tabulated data.

A bimanual distinction in the course of line T is emphasized by Keith ('24), Cummins, Leche and McClure ('31) and Leche ('33a, '36) — a tendency, as the line passes distally, to be more nearly transverse in right hands (as shown for the Indian series in Table 16). It will be noted that the chimpanzee displays a corresponding bimanual unlikeness, notwithstanding the distinctive predominance of longitudinal configurations in both hands.

PALMAR MAIN LINES

Wilder's method of formulation, since modified in some particulars by Cummins *et al.*, provides for the human palm a means of description of the courses of main lines. The same method is employed for the chimpanzee, though the special character of the configurations introduces certain difficulties which make it desirable to depart from the strict application of the rules. If the full value of the main-line formulation is to be derived, especially in the expression of prevailing directions of ridges over the palm, corrections must be made in this chimpanzee material at the sacrifice of description of certain details. Line A, for example, is a highly important element in the picturing of generalized ridge courses, in this respect sharing with line D a significance which is attached only in negligible measure to lines B and C. But owing to the frequent absence in the chimpanzee of the digital triradius (a) from which it arises, about one-fourth the palms actually lack this line. Its expected position, however, may be readily recognized and in formulation it is feasible to project ridge courses from the base of digit II, recording the termination as if the main line were truly

present. In the absence of digital triradius d, the origin of line D, a closely neighboring interdigital triradius may do good service as a descriptive substitute, and several instances of this correction are included in the listed formulae (Table 17).

TABLE 17

Main-line formulae in 40 right hands and 40 lefts, condensed by omission of lines B and C and corrected as explained in text

(Frequencies stated in absolute numbers.)

FORMULA	RIGHT	LEFT
0 — — 1	13	17
0 — — 3	..	1
0 — — 4	1	..
7 — — 1	5	11
9 — — 1	10	7
9 — — 3	1	..
11 — — 1	8	4
13 — — 1	2	..

In human palms the characteristic formulae are 11.9.7.-, 9.7.5.-, and 7.5.5.-, the entry for line A being here omitted since in any one of these formulae (which include in order lines D, C and B) it may reach positions 1, 2, 3, 4 or 5. Typically in right hands line A enters one of the higher positions, and in lefts one of the lower, expressing the bimanual difference in general ridge courses just as line D tends in right hands to reach the more radial terminations (the higher numbers in the formula). In the chimpanzee the characteristic formulae are 0.0.0.1, 7.0.0.1, 9.0.0.1 and 11.0.0.1, these together accounting for 56 of the 80 palms. The remaining formulae are scattered, with usually but one instance of each, among formulae such as the following, and from the standpoint of generalized ridge direction they are not significantly different from the majority types just named: 0.0.1.1; 0.0.2.1; 0.5″.0.1; 7.0.1.1; 7.0.2.1; 7.0.5″.1; 7.5″.0.1; 9.0.1.1; 9.0.2.1; 9.7.0.1; etc. Regularity of the entire formulae, more pronounced than in man, derives from the frequent absence of lines B and C and from the consistent tendency of line A (or its equivalent in ridge courses) to reach position 1; in only three instances does line A reach terminations higher than position 1.

While an inspection of the formulae is alone sufficient to demonstrate that the chimpanzee differs from man in having a pronounced tendency to longitudinal configuration of the palm, the contrast may be stated quantitatively with the use of Cummins' main-line index ('36a). This index is a summation of values for lines A and D. For line A the values are the positions of termination as indicated in the formula (except that the value 6 is substituted for the position 5″), and for line D the values are listed in a code which is a translation of the formulated positions into quantitative terms equivalent in descriptive significance to those of line A. A palm having the highest possible expression of transversality reduces to an index of 14, and the index 2 expresses the most extreme longitudinal configuration. The chimpanzee, combining both hands, yields the index 3.9; the average of the human populations which have been analyzed with the index is roughly twice this figure. Peculiarities of the chimpanzee configurations should be taken into account in this comparison of the index; the topographic relations are such that chimpanzee and man may not be precisely compared by so simple a quantitative means. Considering, for example, that the more radial terminations of line D, particularly as indicated in positions 11 and 13, are associated with a zone of transverse configuration much more limited in proximal extent than are the corresponding terminations in man, it is probable that the figure obtained by using a method designed for human palms is too high. This probable weakness of the quantitative comparison with man does not hold in the bimanual comparisons, which after all are of greater interest. Calculating the index separately for right and left hands, it is shown that dextral and sinistral characteristics

TABLE 18

Main-line indices in the chimpanzee and in several human populations

GROUP	RIGHT	LEFT	BOTH	RIGHT-LEFT RATIO
European-Americans (Cummins)	9.2	7.6	8.4	121
Zapotecas (Leche)	8.9	6.8	7.9	131
Chimpanzee	4.4	3.4	3.9	132
Mixtecas (Leche)	8.5	6.3	7.4	135
Aztecas (Leche)	9.1	5.7	7.4	158

in the chimpanzee are comparable to those in man (Table 18). Configurations of right hands tend to be more transverse in the chimpanzee as well as man, and the magnitude of bimanual difference is of the same order.

PALMAR PATTERNS

On the palm there are five configurational areas (or six, if the thenar/first interdigital area be divided), each of which may be either patterned or patternless. A pattern, in the strict sense here followed, is a system of ridges abruptly recurved to form a discrete design such as a loop or a whorl, while patternless configurations are composed of straight or gently arched ridges. The following section is devoted to the frequencies of configuration types in each area and comparisons with man. The revised methods of Cummins *et al.* are employed for formulation. Data for the human comparisons are drawn not only from the literature but from a series specially compiled for the purpose, hereafter termed the "composite series", consisting of 40 individuals each of Eskimos, Comanche Indians, Cuban Negroes and Cuban whites. These individuals were selected at random from available files of racial material. The frequencies of patterns, as distinguished from patternless configurations are listed in Table 19.

Hypothenar. In the instance of the human hypothenar the patternless configurations are of two chief types: the rare open fields, in which the ridges are straight or nearly straight; and simple arches, corresponding in morphology to the simple arches of finger tips but being subclassified according to the directions which they face, since their situation on the palm admits variable orientations. Hypothenar patterns assume many different configurations; their basic types are treated in the revised methods and a morphological consideration is presented by Cummins ('35).

Viewing the chimpanzee hypothenar configuration in the light of experience with human material, perhaps the most conspicuous distinction is its consistent tendency toward ridge alignments in or approximating the long axis of the hand. This is of course a common trait of primates below man, but in man it is very rarely that configurations in the hypothenar area present this orientation. In the occasional instances where there is a suggestion of similar configuration in man, usually associated with the presence of an arch with its concavity facing radially

TABLE 19

Percentile frequencies of palmar patterns compared in 40 chimpanzees and a composite human series (40 each of Eskimos, Comanche Indians, Cuban Negroes and Cuban whites)

(Bimanual inequalities are indicated in asymmetry indices, right/left or left/right ratios depending upon whether the right or left hand presents the larger frequency.)

PATTERNS	CHIMPANZEE				MAN			
	Right	Left	Both	Asymmetry Index	Right	Left	Both	Asymmetry Index
Hypothenar	59.0	53.9	56.4	109	25.6	23.1	24.4	111
Thenar/first interdigital	55.0	77.5	66.3	141	16.3	24.4	20.9	150
Second interdigital	57.5	57.5	57.5	100	10.6	5.0	7.8	212
Third interdigital	27.5	15.0	21.3	183	50.6	31.3	40.9	162
Fourth interdigital	67.5	55.0	61.3	123	57.5	71.9	64.7	125
AVERAGE ASYMMETRY INDICES				131				152

or with an uncommon form of L^r pattern (see below), the relations are still quite different from the condition in the chimpanzee, in which such a configuration occupies a much greater expanse of the palm. The contrast between the more transverse tendencies of the human palm and the longitudinal configuration of the chimpanzee, already emphasized in the discussion of the main lines and line T, is exemplified also in the unlike course of ridges as they pass distally from the proximal hypothenar region. In man outflowing ridges pass almost invariably to the first interdigital interval, while in the chimpanzee they are commonly directed to the second or even the third interspace.

The total occurrences of patterns, as opposed to patternless configurations, may be compared in chimpanzee and man. In chimpanzee 56.4 per cent of the hands bear true patterns. This indicates a greater frequency than in man, for in a racially composite collection numbering some 2800 hands Cummins ('35) reports a pattern incidence of only 34.5 per cent. Races vary, however, and the discrepancy is even larger if some races be selected, as indicated in this summary of hypothenar occurrences made by Steggerda, Steggerda and Lane: "America Indians 5 to 17 per cent, Mongolians 12 to 30 per cent, Negroes 15 to 21 per cent, and Whites 32 to 45 per cent". It is thus evident that the chimpanzee frequency does not much exceed that of the "Whites", large as the difference is in comparison with certain peoples. There is a slight excess, as in man, on right hands.

The varieties of configuration are shown in Figs. 1-20. Patternless configurations are almost entirely accounted for by simple arches having the concavity facing radially (A^r), found on 43 per cent of the hands. This is a rare configuration in man, where according to the 1935 series, numbering some 2800 palms, the frequency is only 0.7 per cent. In man the chief patternless configurations are of other types (A^u and A^u/A^c) which together amount to about 64 per cent of the total configurations. The most abundant true pattern of chimpanzee is a large loop with its opening directed distally (L^d), the homologue of L^r in man. While it differs in detailed design from the typical L^r pattern, closely similar configurations do occasionally occur in man (see Figs. 23-24, Cummins, '35).

A division of the primary hypothenar configuration into distal and proximal elements, as well as duplex expressions of the proximal element, appear in the chimpanzee as in man. Only one case of patterning of the distal element has been reported in man. But one of 79 chim-

panzee hands exhibits what is interpreted as this distal element expressed as a true pattern, independent of the proximal element of the hypothenar.

Thenar/first interdigital patterns are large and conspicuous, differing from the characteristic configurations in man particularly by their greater relative expanse and clean-cut definition as well-modeled patterns. With an occurrence of 66 per cent they are further distinctive in frequency, for as noted in the human composite series thenar/first interdigital patterns occur in but 21 per cent of the hands. Consideration of separate races reveals a large range of variation in this respect, however, and the chimpanzee does not stand very far above some groups of American Indians. Steggerda, Steggerda and Lane state in summary of racial variation: "The Mongolians show unusually low percentile occurrences; namely, 5.3 to 16.3 per cent, the Negroes 15 to 19 per cent, and the Whites 5 to 18 per cent, while in American Indians the occurrence ranges from 15 to 50 per cent with the highest percentages most characteristic". It should be noted that in the human populations thus far studied the thenar/first interdigital pattern is more abundant in left hands, an asymmetry which occurs also in the chimpanzee.

As to the detail of the configuration it may be mentioned that the chimpanzee agrees with man in that the majority of the patterned configurations exhibit discrete thenar and first interdigital elements — forms formulated as O/L, L/O, L/L, etc., while in others a pattern may be of such extent and position as to suggest that the two elements are blended in one, formulated L, T, etc., just as in a patternless configuration the two elements are indistinguishable.

The numbers are insufficient to provide more than a hint of possible bimanual difference in the expressions of the separate thenar and first interdigital elements, but there is a suggestion that it is the first interdigital element in which the sinistral predominance is particularly evident. The large blended patterns are more common in left hands, as are all patterns combined, but when the elements of dual configurations are separately analyzed the following suggestion of their unlike bimanual behavior in pattern occurrence is revealed: the discrete first interdigitals appear in 10 right hands and 15 lefts, while the discrete thenars occur in 13 right hands and 11 lefts. It is accordingly possible that the thenar element is influenced to some extent by the same factors which lead to the dextral predominance of the adjoining hypothenar pattern.

There are seven palms, all lefts but one, which display an additional pattern tentatively identified as the distal element of the first inter-

digital pattern. The basis of this interpretation is that in the human fetus, prior to the involution of the volar pads, the first interdigital pad is represented by two distinct elevations, the more proximal one in close relation to the thenar pad (with which it shares the association with the ordinary thenar/first interdigital patterns), and the more distal one in conjunction with the second interdigital pad (Cummins, '29). The occurrences of these patterns are not included in the tabulated figures in order that comparison with man may be based upon the same pattern elements. Four of the seven patterns occur in association with the usual types of thenar/first interdigital patterns, and the addition of the three cases occurring in company with open fields of the usual thenar/first area would raise the total pattern incidence from 66 per cent to 71 per cent. The three patterns here disclosed in the chimpanzee occupy positions which point to their association with a distal first interdigital pad of this nature; such patterns apparently have not been observed in man, though even in the adult there is a slight mound commonly persisting in a corresponding position.

In the reported human collections there is an inverse relation in the frequencies of hypothenars and thenar/first interdigitals. If there were a people having hypothenars as abundant as 56.4 per cent the expected frequency of thenar/first interdigitals would be only several per cent, while in the chimpanzee these patterns (66 per cent) are actually more abundant than the hypothenars.

Second interdigital patterns occur in over half the palms (57.5 per cent). The incidence would be increased to 61.3 per cent by the addition of the three patterns which are interpreted as distal elements of the first interdigital, but it is clear that the patterns in question are more properly assigned to the first interdigital than to the second.

Second interdigitals, the rarest of the palmar patterns in man, occur in 8 per cent of the hands in the composite series. When in man the configuration appears as a true pattern, not simply a vestige, its typical form is that of a loop (with or without an accessory triradius) opening into the second interdigital interval. In the chimpanzee the characteristic pattern, accounting for 34 of the 46 cases of patterns, is a loop with its opening directed proximally; excepting one vestige, the remainder is composed of whorls and loops comparable to those in man. Nine of the examples of the proximal-opening loops are patterns which are broadened to extend across the territories of both the second and third interdigital configuration areas. They are clearly a blending of the

two configuration complexes into a single pattern, hence the occurrences of these broad loops are registered under the headings of both the second and third interdigitals (below). In contrast with the human characteristic of a marked excess of patterns in right hands, the chimpanzee presents a symmetrical bimanual distribution.

Third interdigital. In the chimpanzee third interdigitals are the least common of all palmar patterns (21 per cent), contrasting with the occurrence of 41 per cent in the composite series but included within the range of racial variation, which extends from frequencies as low as 16 per cent to as much as 63 per cent. As in man, the patterns are more frequent in right hands. All the examples except two are proximally opening loops, the exceptions being one whorl and one loop opening ulnarwards. Human third interdigital patterns almost invariably are loops with their openings passing to the third interdigital interval.

Fourth interdigital patterns appear in 61 per cent of the hands. This occurrence is not significantly different from the 65 per cent frequency noted in the composite series, and it may be added that various human populations exhibit frequencies both lower and higher than this. Of the 49 patterns all but 4 are simple loops, with their openings directed distally and radialwards. In fourth interdigital patterns of man, which are nearly always of the same loop form, the openings are related to the fourth interdigital interval; and while in chimpanzee there is a modal frequency of openings in this interval, a large number of the loops extend radialwards to open into the third, second and even the first interval, oftentimes aligned so that the outflowing ridges encroach upon the basal segments of digits IV and III. Human fourth interdigital patterns are more common in left hands, a condition which is reversed in the chimpanzee.

Symmetry. In dealing with symmetry in finger prints bilateral comparisons were made on the basis of pattern types. For the palmar configurations a different approach is indicated, the criterion of presence or absence of patterns in the areas compared.

Applying this criterion, and first making use of the total frequencies of patterns in each of the five configurational areas of right and left hands, the data in Table 19 may be inspected for bimanual comparisons. Chimpanzee and man agree in presenting dextral predominance of hypothenar and third interdigital patterns, and sinistral predominance of thenar/first interdigital patterns. The magnitudes of bimanual in-

equality in these three patterns may be considered equivalent in chimpanzee and man, a fair margin being allowed for error inherent in the use of a small series. But the fourth interdigital pattern shows a reversed asymmetry in the two forms, being more abundant in right hands of the chimpanzee in contrast to sinistral predominance in man; the magnitudes of asymmetry, however, are equal. Second interdigital patterns present what amounts to a partial reversal, if the exact symmetry of the chimpanzee may be regarded as an elevation of sinistral frequency which cancels the dextral predominance characteristic in man; the magnitude of difference between chimpanzee and man leaves little doubt that the distinction is statistically significant. The conclusion drawn from these findings is that the axial relations which determine bimanually unlike pattern frequencies differ in chimpanzee and man. The two proximal configurational areas (hypothenar and thenar/first interdigital areas) behave exactly the same in chimpanzee and man, as does the intermediate one of the three distal configurational areas (third interdigital). In contrast, the more marginal distal configuration areas (second and fourth interdigitals) display asymmetrical pattern expressions each in the same manner as its immediate proximal neighbor, the thenar/first interdigital and hypothenar respectively. To phrase the comparison in another way, three patterns on the ulnar side of the chimpanzee palm are more abundant in right hands, and the patterns on the radial side are either predominant sinistrally or symmetrical in the two hands; the patterns are grouped in two longitudinal series, while in man the patterns having common attributes of bimanual asymmetry lie in two obliquely intersecting fields.

A measure of the degree of symmetry in chimpanzee and man may be determined simply by counting the number of instances in which the configuration areas are symmetrical in right and left hands, both being patternless or both patterned. A compilation of the palms from this standpoint is presented in Table 20, and for each of the four racial groups composing the composite series a similar record has been made. This table lists, for each of the configuration areas and for the groups separately, the total number of individuals having symmetrical configurations. To level the fluctuations which are to be noted in the results for the single configuration areas, the significance of which can not be stated in these small series, comparisons may be drawn with the use of the average of the five areas. These averages represent in each group a theoretical number of individuals (not actual because it repre-

TABLE 20

Symmetry in palmar configurations: the number of individuals (in a total of 40) in whom right and left hands are both patterned or both patternless

	CHIMPANZEE	ESKIMO	COMANCHE	CUBAN NEGROES	CUBAN WHITES
Hypothenar	27	33	32	36	31
Thenar/first interdigital	29	33	30	38	38
Second interdigital.....	32	39	40	36	34
Third interdigital.....	35	28	29	27	27
Fourth interdigital.....	33	25	27	29	28
AVERAGE.....	31.2	31.6	31.6	33.2	31.6

sents a compounding of the five areas) who are symmetrical in a total of 40; chimpanzee, 31.2; Eskimo, 31.6; Comanche, 31.6; Negro, 33.2; whites, 31.6. It may be stated, therefore, that the degree of total symmetry is equivalent in chimpanzee and man. It is interesting to observe that this expression of symmetry is independent of the number of patterns concerned, and is accordingly not a function of tendencies within a group to the appearance or suppression of patterns. It will be evident that 400 configuration areas are being considered in each group of 40 individuals. The following figures are the number of these which are patterned: chimpanzee, 209; Eskimo, 116; Comanche, 118; Negro, 130; whites, 144.

Pattern distribution. It is of interest to inquire into the evenness of distribution of patterns in the several configuration areas, as was done in the case of whorls on the finger tips. Assuming that the presence of patterns on all areas is a primitive state and that their effacement proceeds in an irregular fashion associated with regional specializations which involve one or more patterns differentially, a measure of their collective trends is desirable. With five pattern areas concerned (combining the thenar and first interdigital), the measure may be determined by comparing the frequency of each pattern with that of the next higher frequency, expressed as a percentile relation. The four percentages are then averaged as an index of the collective trends. It is

obvious that an average of 100 would be obtained if patterns were consistently present on all areas or if they were equally effaced on all areas, and that successively lower figures indicate increasing inequality of the pattern frequencies. Figures based on this comparison are listed in Table 21.

TABLE 21

Differences in pattern frequencies among the five configurational areas of the palm, expressed in percentile relations of the frequency of the pattern which is second in abundance to that most abundant, the third in rank of frequency to the second, etc.

					AVERAGE
Chimpanzee	92	95	97	38	81
European-Americans (Cummins, Leche and McClure)	84	90	16	67	64
Composite series	63	59	88	38	62
West-African Negro (Cummins)	34	60	89	63	62
Koreans (Miyake)	36	67	100	19	56
Comanche (Cummins and Goldstein)	55	86	57	18	54
Chinese (Wilder)	15	92	67	13	47
Maya (Steggerda, Steggerda and Lane)	78	55	44	8	46
Japanese (Hasebe)	46	62	28	40	44
AVERAGE, EXCLUDING CHIMPANZEE					54

The chimpanzee palm not only bears more frequent patterns (average of the five areas 52.6 per cent, as compared with 31.7 per cent in the human composite series), but these patterns are more equally distributed among the five areas. The chimpanzee yields a distribution value of 81, derived as stated above, while the nearest human value is 64 and the average for the several human collections is 54

PLANTAR PATTERNS

Sixty-four sole prints, from 32 animals, are utilized in the following analyses of digital triradii and the occurrences of patterns in each of six pattern territories. Pattern frequencies, with data for comparison with man, are given in Tables 22 and 23.

TABLE 22

Percentile frequencies of plantar patterns combined in 32 chimpanzees and

TABLE 22

Percentile frequencies of plantar patterns compared in 32 chimpanzees and a composite human series (32 each of European-Americans, Maya Indians, Navajo Indians and Eskimos)

(The so-called hallucal pattern of man is evidently the homologue of two patterns which appear separately in the chimpanzee, the thenar and first interdigital, while the patterns known in man as the first, second and third interdigitals correspond respectively to the second, third and fourth interdigitals of the chimpanzee—opposite which they are here entered for comparison.)

	CHIMPANZEE			MAN		
	Right	Left	Both	Right	Left	Both
Hypothenar	71.9	71.9	71.9	...	...	...
Thenar	81.3	81.3	81.3*	92.2	90.6	91.4
First interdigital	25.0	21.9	23.4			
Second interdigital	15.6	18.8	17.2	25.0	25.0	25.0
Third interdigital	12.5	6.3	9.4	69.5	67.2	68.4
Fourth interdigital	46.9	43.8	45.3	11.7	10.2	10.9

* Since the single human hallucal pattern is to be compared with two distinct patterns in the chimpanzee (thenar and first interdigital) it must be noted that the frequency of patterns comparable to the human hallucal is 92.2 per cent, representing the total of all configurations where both thenar and first interdigital occur and those in which either appears alone. There are seven feet in which a first interdigital pattern occurs without a companion thenar, and the addition of these to the 81.3 per cent frequency of thenars raises the total to 92.2 per cent.

TABLE 23

Percentile frequencies of patterns in the plantar areas: chimpanzee compared with several racial groups

(The entries of the human configurations are as explained in Table 22, conforming to morphology rather than to the customary names.)

	THENAR/FIRST INTERDIGITAL	SECOND INTERDIGITAL	THIRD INTERDIGITAL	FOURTH INTERDIGITAL
European-Americans[1]	95.7	30.4	68.2	17.6
Negroes[2]	95.0	33.6	71.3	35.0
Maya[3]	94.4	23.5	66.7	16.0
Siamese[4]	93.4	6.6	57.9	15.8
Chimpanzee	92.2	17.2	9.4	45.3
Japanese[5]	92.1	10.9	52.5	4.8
North American Indians[6]	91.3	23.5	60.1	11.7
Eskimo[7]	75.7	16.8	64.7	7.4

[1] Weighted averages of two collections together numbering 2400 subjects: Cummins and Midlo, '26; Montgomery, '26.

[2] Cummins, '30a.

[3] Weighted averages of two collections together numbering 160 subjects: Cummins, '30b; Cummins and Steggerda, '36b.

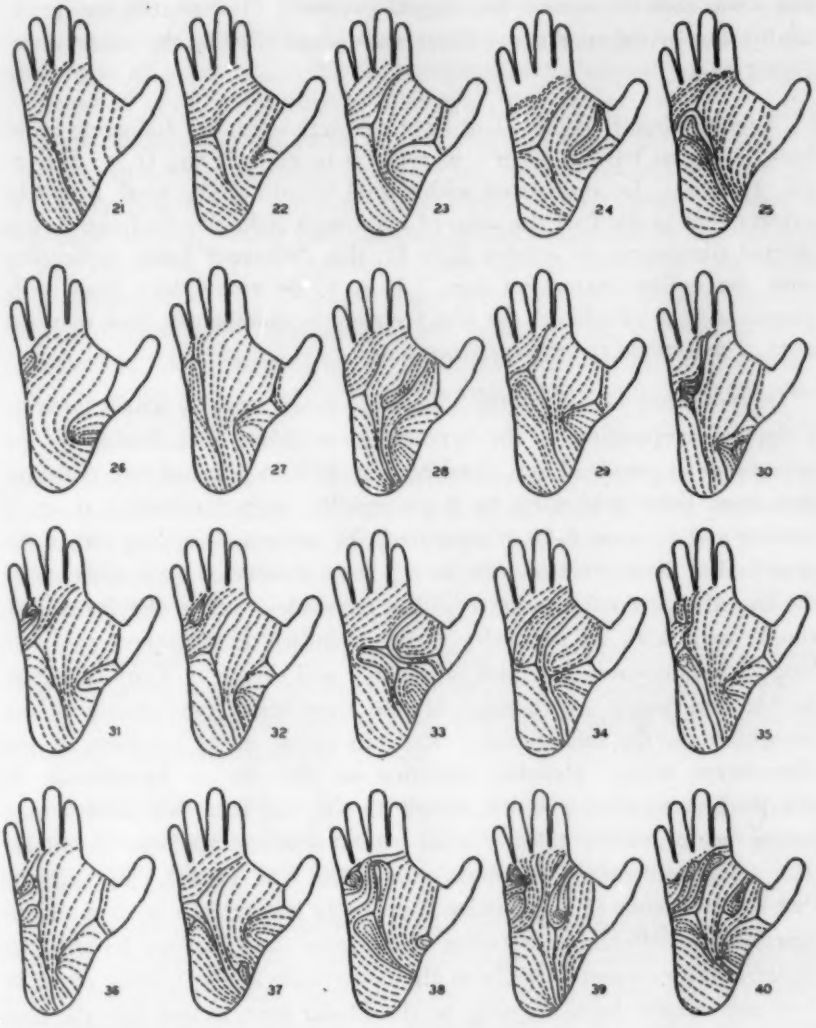
[4] Cummins, '34.

[5] Wilder, '22.

[6] Unpublished data on 311 subjects, Cummins.

[7] Weighted averages of two collections together numbering 95 subjects: Midlo and Cummins, '31; Cummins, '35.

The pronounced longitudinal ridge alignments are in conspicuous contrast to the generalized transverse or only slightly oblique configurations existing in man. Thus both hand and foot of the chimpanzee display a like trend of difference from the homologous human members. This characteristic is most strikingly exhibited in a sole completely devoid of patterns, of which there is one example in the series (Fig. 21). The triradius here present, an almost constant feature of the chimpanzee sole, is Schlaginhaufen's triradius 9. Its radiants divide the sole into three chief fields: the largest area on the tibial side, comprising the sites, as they are presented in other soles, of the thenar, first interdigital



FIGS. 21-40. INTERPRETATIONS OF TWENTY CHIMPANZEE SOLES, SO SELECTED FROM A SERIES OF SIXTY-FOUR AS TO EMBRACE THE RANGE OF REPRESENTATIVE VARIATIONS

Both right and left feet are included, but for convenience of comparison all are drawn as direct views of right members (or prints of lefts) and all are reduced to the same scale.

and sometimes the second interdigital patterns; fibularwards and proximally, the hypothenar area; fibularwards and distally the outer interdigital areas.

Digital triradii. Combining right and left soles, the following numbers of digital triradii occur: in relation to digit I, 59; II, 7; III, 5; IV, 7; V, 24. In comparison with digital triradii of the hand, it will be evident that in the foot the zone of maximum reduction in frequency is shifted tibialwards to involve digit II, this difference being in keeping with the unlike anatomical axes. It is to be emphasized that while plantar digital triradii are far less frequent in chimpanzee than man the axes of maximum reduction correspond.

Hypothenar. Fifty of the soles have configurations which point to a duplex composition of the hypothenar territory, as indicated by the occurrence in proximal and distal relation to each other of two patterns, two open fields separated by a proximally shifted triradius 9, or a pattern and an open field so separated, the pattern occupying either the proximal or distal position. In the 14 soles which lack these indications the hypothenar configuration is either patternless (as in the form of a simple arch with its concavity facing tibially) or patterned (a large loop with its opening extended proximally and tibially). Corresponding double and single expressions of the hypothenar configurations are recognized in the human sole. Patterns occur in 72 per cent of the chimpanzee soles. Reliable statistics on the plantar hypothenar in various human races are few, owing to the fact that this pattern may escape being printed unless special precautions are applied. Available data (Schlaginhaufen, Cummins and Midlo, '27; Takeya, '34) suggest that the frequency in chimpanzee is probably higher than in man. Configurational differences between chimpanzee and human hypothenar patterns are evidenced chiefly in the occurrence in the former of more frequent whorls, loops opening on the fibular margin and into the first interdigital interval, and the longitudinal inclination of the loops which extend to the proximal and tibial margins.

Thenar. Thenar patterns occur in 81.3 per cent of the soles, and their characteristic form (43 cases) is that of a loop opening to the tibial margin. For comparison with man the thenar and first interdigital are treated together.

First interdigital. First interdigital patterns occur more commonly in company with thenar patterns, but may appear alone. Their frequency is 23.4 per cent. The characteristic configuration is a large loop opening in the first interdigital interval.

The human hallucal pattern is ordinarily a single pattern, but it is morphologically a combination of first interdigital and thenar pad elements (Cummins, '29), an origin which is very rarely reflected by the occurrence of double patterns such as that illustrated by Montgomery ('26; Fig. 1A). Thus the homologous configurations of chimpanzee are distinctive in retaining the more primitive trait of expression of separate patterns. Their frequencies, however, are equivalent, if we combine all cases wherein either the thenar or first interdigital occurs independently with those in which the two patterns appear in the same foot.

Second interdigital. This pattern occurs in 17.2 per cent of the soles, always in the form of a narrow loop which is directed proximally, toward either the tibial or fibular border on which it typically opens. The frequency is equivalent to the occurrence of human second interdigital patterns.

Third interdigital. The third interdigital is invariably a loop, opening on the tibial border, fibular border, or in the first interdigital interval. With an occurrence of only 9.4 per cent, this pattern is notably less frequent than its homologue in man.

Fourth interdigital. This pattern is typically either a loop opening to the fibular border or a whorl. The occurrence of 45.3 per cent is distinctively greater than in man.

Symmetry. A measurement of symmetry determined by total pattern occurrences on right and left sides is of doubtful value, due both to the questionable significance of the small differences in bilateral frequencies (Table 22) and to uncertainties in the status of bipedal differences in man. A determination may be made, however, simply by counting the number of symmetrical instances in each configuration area, and striking an average which represents the number of symmetrical (theoretical) individuals. These counts and averages are listed in Table 24, including the chimpanzee and four racial groups for comparison.

TABLE 24

The occurrence, in absolute numbers, of symmetry in the plantar configurations, combining the individuals in which right and left configurations of the designated areas are either both patterned or both patternless

(The entries of the human configurations are as explained in Table 22, conforming to morphology rather than to the customary names. Each group is composed of 32 individuals.)

	CHIMPANZEE	AVERAGE OF THE FOUR HUMAN SERIES	EUROPEAN-AMERICANS	ESKIMO	MAYA	NAVAJO
Hypothenar	26	...	..	..	..	..
Thenar	30	28.5	31	21	32	30
First interdigital	29					
Second interdigital	29	27.5	26	30	27	27
Third interdigital	30	27.8	27	30	26	28
Fourth interdigital	25	29.0	24	31	29	32
AVERAGE	28.2	28.2	27.0	28.0	28.5	29.3

Pattern distribution. By the same procedure as that employed for the palm and with the same aim, the evenness of pattern distribution on the sole is determined and compared with man (Table 25).

The chimpanzee sole has a distribution value of 47, and ranks with human populations, though as shown above the value for its palm is notably in excess of the human. The difference between palm and sole of the chimpanzee is in sharp contrast to the situation in man, where the values in palm and sole are in essential agreement.

DISCUSSION

In considering the possible significances of findings in the chimpanzee dermatoglyphics it is desirable to recall the mechanism by which their characteristics are conditioned. The immediate determining factors in the developmental regulation of ridge alignments (third and fourth months in the human fetus) are at least in part complexes of forces associated with the growth of specific conformations of the member (Cummins, '26; Bonnevie, '32; Schaeuble, '34; Abel, '36). Among the conformations of particular interest in this connection are the volar pads (walking pads; Tastballen), a series of elevations which in pentadactyl mammals are consistent in number and position. In the lower primates the pads are commonly developed with a marked fullness, and large distinct patterns are in consequence more common than in anthropoids. In the macaque (Cummins, '33) patterns are relatively much larger than in chimpanzee and man, and in individuals patterns are less frequently suppressed; in the macaque fetus (Schultz, '37) volar pads are even more prominent than in the postnatal state. In anthropoids patterns are not so common nor do they generally occupy such relatively large areas. In the human fetus (Cummins, '29) all the pads are initially developed, but they undergo involution, some pads regressing more rapidly than others, and it may be assumed that this early history is paralleled in the chimpanzee. Advanced involution of a pad prior to the period of ridge differentiation leads to the production of a patternless configuration in its site, while the irregular reliefs associated with partial regression result in increased diversity in varieties of patterns. In chimpanzee and man alike the pattern frequencies indicate that members of the pad series regress differentially, and with significant differences in their behavior in the two forms. Certain distinctive items in the chimpanzee dermatoglyphics, especially the prevailing longitudinal ridge alignments, the marked reduction of digital

triradii and increased abundance of palmar interdigital triradii, reflect a developmental conditioning quite unlike that associated with the growth of a human hand and foot. To contrast them in chimpanzee and man is but to emphasize the already plain distinctions in conformation of their members (Fig. 41).

Pattern frequencies are a measure of more fundamental attributes, and afford a means of comparing chimpanzee and man with respect to bilateral symmetry and axial relations within the single hand and foot.

When dealing with comparative pattern frequencies, the available data from various human populations stand as a constant reminder of the need for cautious generalization. Racial, sexual and constitutional variations in pattern frequencies have been demonstrated, and the magnitude of difference among the populations is often considerable. One who wishes to stress a supposed phylogenetic significance of the frequency of some pattern in the chimpanzee, for example the abundance of the palmar thenar/first interdigital, must explain at the same time its wide range of variation among human races. It is quite true that a frequency of 66 per cent is higher than the maximum frequency in any known racial group (about 50 per cent in Indians of Middle America), but this is in turn about nine times the minimum frequency observed in other groups! From their manner of development the dermatoglyphics are sensitive indicators, and while it is not impossible that convergent effects on pattern frequency may result from unrelated influences an inquiry into affinities among the primates must take into account the directions and qualities of variation within the human species, where alone is it possible to secure adequate collections for their demonstration.

As a gauge of primitiveness (or more specifically, fetalization) the total occurrences of patterns, and in finger tips especially the frequency of whorls, may be useful, though subject to the qualification just mentioned. With this criterion the finger tips of the chimpanzee and the plantar patterns collectively are on a par with man, while the more abundant palmar patterns indicate greater primitiveness of this member. These indications may be supplemented by observations on the evenness of distribution of whorls among the five digits, and of pattern frequencies among the several configuration areas of the palm and sole. The finger tips, despite the lack of distinction from man in total whorl frequencies, exhibit a lesser degree of digital specialization in whorl distribution. The palm by this measure is likewise less specialized than the human palm, while the sole is on a par with that of man. By both

FIG. 41. THE RIGHT HAND AND RIGHT FOOT OF AN ADOLESCENT MALE CHIMPANZEE, PHOTOGRAPHED IN LIFE

The palmar reliefs are somewhat deformed by pressure against a sheet of glass, applied as a means of extending the digits which ordinarily are held flexed.

criteria the palm of the chimpanzee is more primitive than the sole; in man the sole is the more primitive in terms of collective pattern frequencies, though palm and sole are on the average equal in the evenness of pattern distribution.

We may now compare chimpanzee and man with attention to the single pattern areas. Whorls are distributed on the finger tips as in man with maximum frequencies on digits I and IV (the introduction of digit II in the sequence, Table 2, being probably explained by the small size of the series). The excess of patterns in the chimpanzee palm, as compared with man, is due entirely to the greater abundance of hypothenar, thenar/first interdigital and second interdigital patterns. Palmar third and fourth interdigital areas are patterned with equal frequency in chimpanzee and man, but these areas in the soles are unlike, the greatest difference being the extreme reduction of third interdigital patterns in the chimpanzee. The reversal, in relation to the long axes, of zones of unlikeness in palm and sole is worthy of emphasis. Plantar hypothenars are more abundant in the chimpanzee. It will be evident that these local differences between chimpanzee and man do not gain recognition in the collective comparisons of pattern frequencies; in the areas wherein they are different at all the palms are more different than a summation treatment indicates, while in the soles the local differences are excesses and reductions which mutually cancel in a summated comparison of all patterns.

The distributions of arches and radial loops of the finger tips again indicate a different axial relation of the factors determining these patterns. In the chimpanzee arches occur on digits IV and V, while in man they are located mainly on II and III. Radial loops in the chimpanzee are concentrated on digit I, rather than on II. In these items the chimpanzee fingers resemble human toes.

In other features which may be descriptively referred to the anatomical axes of the hand and foot, chimpanzee and man agree as follows: the prevailing slants of the configurations of middle and proximal phalanges of the fingers; the zone of maximum occurrence of palmar interdigital triradii; the zones of most reduced digital triradii, in both palm and sole.

It is more interesting to find symmetry, or better the expression of asymmetry, paralleled in chimpanzee and man. The soles in both forms are quite symmetrical, at least in the matter of pattern frequencies which are the only characters compared. But in finger prints, frequencies of

palmar patterns, and the generalized alignment of configurations there are asymmetries of like kind in chimpanzee and in man.

The likenesses of bimanual asymmetry in chimpanzee and man afford an interesting background for the consideration of handedness. Repeated references have been made above to characteristic dextral and sinistral distinctions in the dermatoglyphics of human finger tips and palms. These trends are exhibited in groups of subjects selected at random insofar as handedness is concerned; it is evident that they are associates of the predominance of right-handedness, for when comparisons are made between groups of right-handed and left-handed subjects it is found that the usual bimanual distinctions tend to be leveled or even reversed in the left-handed (Keith, MS, '24; Bettmann, '32; Leche, '33b; H. H. Newman, '34; Cummins, '36b).

Reliable information concerning handedness in the several anthropoid apes is not extensive. In 1929 the available material was ably summarized and evaluated by Yerkes and Yerkes in their volume on the great apes; little of significance on this topic has appeared since then. The evidence which they review indicates that preferential use of one hand, foot, or eye, has been demonstrated for each of the anthropoids in individual cases, but that statements asserting that any or all of the anthropoids are generally left- or right-handed, or that an individual is consistently and uniformly one or the other, have not been supported with any degree of convincingness. With regard to the evidence for chimpanzee, reports of handedness in particular animals have appeared several times in the literature. Some observers have even gone so far as to state that most chimpanzees are definitely right-handed (e.g., Sheak, '24), while certain others have asserted that the genus is left-handed (e.g., Mollison, '08, '10-'11). Yerkes and Yerkes (p. 217) conclude their examination of the problem of handedness in chimpanzee thus:

> Our own observations agree with those of other authors in indicating that a particular specimen may be either right- or left-handed, but they further indicate that the hand preference may vary from time to time and in accordance with the nature of the activity in point. Furthermore, preference is not limited to the hand, but extends to foot and even to eye . . . . . .

Although preferential use of one hand or the other can be demonstrated in chimpanzee, the preference seems to be neither as definitely established nor as permanent as is ordinarily the case for man. The fact remains that chimpanzee exhibits bimanual dermatoglyphic assym-

metries comparable to those in man, where there is a prevailing right-handedness and a statistically demonstrable correlation of these asymmetries with handedness.

TABLE 25

Differences in pattern frequencies among the thenar/first interdigital and succeeding interdigital areas of the sole, expressed in percentile relations of the frequency of the pattern which is second in abundance to that most abundant, the third in rank of frequency to the second, and the fourth to the third

(Sources of the racial material indicated in Table 23.)

				AVERAGE
Negroes	75	49	96	73
Maya	71	35	68	58
European-Americans	71	45	58	58
Composite series	75	37	44	52
Eskimos	85	26	44	52
North-American Indians	66	39	50	52
Chimpanzee	49	38	55	47
Siamese	62	27	42	44
Japanese	57	21	44	41
AVERAGE, EXCLUDING CHIMPANZEE				54

SUMMARY

Dermatoglyphics (except toe patterns) in chimpanzee (26-40 animals) differ from the human features as follows: finer ridges; more pronounced longitudinal configuration of palm and sole; arches on fingers IV and V instead of chiefly II and III; radial loops chiefly on thumb instead of index; ulnar loops narrower; reduced number of digital triradii on palm and sole, but with the same relation of the zones of maximum reduction to the anatomical axes; increased interdigital triradii; palmar patterns show larger frequency of hypothenar, thenar/first interdigital and second interdigital; plantar patterns show larger frequency of hypothenar and fourth interdigital, with reduced third interdigital. Except for detailed differences in the characteristics of patterns other features correspond closely.

Larger pattern frequencies, with the more nearly equal distribution of whorls on fingers and the more nearly equal distribution of patterns on the palm indicate greater primitiveness (fetalization) of the hand as a whole, but by these criteria the plantar patterns compare closely with man, and in both members the unlike frequencies of homologous patterns indicate the existence of regional differentials. The asymmetries of finger-tip patterns, palmar main lines, and frequencies of palmar patterns compare almost exactly in direction and magnitude with corresponding asymmetries in man. Plantar pattern frequencies are quite symmetrical in both chimpanzee and man.

LITERATURE CITED

ABEL, W. 1933. Papillarmuster ostgrönländischer Eskimos. *Wissenenschaftliche Ergebnisse (Anthropologie) der Grönland-Expedition Alfred Wegener*, vol. 6, pp. 1-23. *Leipzig*, F. A. Brockhaus.

———. 1936. Über Störungen der Papillarmuster. I. *Zeitschr. f. Morph. u. Anthrop.*, vol. 36, pp. 1-38.

ALIX, M. 1867-1868. Recherches sur la disposition des lignes papillaires de la main et du pied, precedées de considerations sur la forme et les fonctions de ces deux organes. *Ann. des Sc. nat., 5me ser. Zoologie*, vol. 8, pp. 295-362; vol. 9, pp. 5-42.

BETTMANN, S. 1932. Die Papillarleistenzeichnung der Handfläche in ihrer Beziehung zur Händigkeit. *Zeitschr. f. Anat. u. Entwick.*, vol. 98, pp. 649-674.

BONNEVIE, K. 1924. Studies on papillary patterns of human fingers. *J. Genet.*, vol. 15, pp. 1-111.

———. 1932. Zur Mechanik der Papillarmusterbildung. II. Anomalien der menschlichen Finger- und Zehenbeere, nebst Diskussion über die Natur der hier wirksamen Epidermispolster. *Arch. Entwicklungsmech.*, vol. 126, pp. 348-372.

BYCHOWSKA, M. 1930. The configuration of papillary lines in the primate palm. *Folia Morph.*, vol, 2, pp. 69-121. [In Polish.]

CUMMINS, H. 1929. The topographic history of the volar pads (walking pads; Tastballen) in the human embryo. *Contr. to Embryol., Carnegie Inst. Wash.*, vol. 20, pp. 103-126.

———. 1930a. Dermatoglyphics in Indians of southern Mexico and Central America. *Am. J. Phys. Anthrop.*, vol. 15, pp. 123-136.

———. 1930b. Dermatoglyphics in Negroes of West Africa (Liberia and Sierra Leone). *Am. J. Phys. Anthrop.*, vol. 14, pp. 9-21.

———. 1933. Dermatoglyphics [of *Macaca mulatta*]. Chapter IV in "The Anatomy of the Rhesus Monkey", Hartman-Straus. *Baltimore*, Williams and Wilkins.

———. 1934. Plantar dermatoglyphics and tread area in Siamese. *Am. J. Phys. Anthrop.*, vol. 19, pp. 321-325.

———. 1935. Morphology of the palmar hypothenar dermatoglyphics in man. HUMAN BIOLOGY, vol. 7, pp. 1-23.

———. 1936a. Methodology in palmar dermatoglyphics. In *Measures of Men*, Pub. No. 7, *Middle American Research Series*, Tulane University, pp. 23-81.

———. 1936b. Finger prints correlated with handedness. *Proc. IV Congresso Federativo internazionale di Anatomia*, Milano, p. 28. [Abstract.]

———, and M. S. GOLDSTEIN. 1932. Dermatoglyphics in Comanche Indians. *Am. J. Phys. Anthrop.*, vol. 17, pp. 229-235.

———, H. H. KEITH, C. MIDLO, R. B. MONTGOMERY, H. H. WILDER, and I. W. WILDER. 1929. Revised methods of interpreting and formulating palmar dermatoglyphics. *Am. J. Phys. Anthrop.*, vol. 12, pp. 415-473.

———, S. LECHE, and K. MCCLURE. 1931. Bimanual variation in palmar dermatoglyphics. *Am. J. Anat.*, vol. 48, pp. 199-230.

———, and C. MIDLO. 1926. Palmar and plantar epidermal ridge configurations (Dermatoglyphics) in European-Americans. *Am. J. Phys. Anthrop.*, vol. 9, pp. 471-502.

———, ———. 1927. Dermatoglyphics in Jews. *Am. J. Phys. Anthrop.*, vol. 10, pp. 91-113.

———, and J. SICOMO. 1923. Plantar epidermal configurations in low-grade syndactylism (zygodactyly) of the second and third toes. *Anat. Rec.*, vol. 25, pp. 355-389.

———, and M. STEGGERDA. 1935. Finger prints in a Dutch family series. *Am. J. Phys. Anthrop.*, vol. 20, pp. 19-41.

———, ———. 1936a. Finger prints in Maya Indians. In *Measures of Men*, Pub. No. 7, *Middle American Research Series*, Tulane University, pp. 103-126.

———, ———. 1936b. Plantar dermatoglyphics in Maya Indians. *Maya Research*, vol. 3, pp. 277-286.

DANKMEIJER, J. 1934. De Beteekenis van Vingerafdrukken voor het anthropologisch Onderzoek. *Utrecht*, L. E. Bosch & Zoon, pp. 98.

FERE, C. 1900. Notes sur les mains et les empreintes digitales de quelque singes. [And other related studies appearing in the same volume.] *J. de l'Anat. et de la Physiol.*, vol. 36, pp. 255-267.

FLEISCHHACKER, H. 1934. Untersuchungen über das Hautleistensystem der Hottentotten-Palma. *Anthrop. Anz.*, vol. 11, pp. 111-148.

GEIPEL, G. 1935. Anleitung zur erbbiologischen Beurteilung der Finger- und Handleisten. *München*, J. F. Lehmann.

———. 1937. Der Formindex der Fingerleistenmuster. *Zeitschr. f. Morph. u. Anthrop.*, vol. 36, pp. 330-361.

GRUNEBERG, H. 1928. Untersuchungen über die Asymmetrie der Tastfiguren. *Zeitschr. indukt. Abstammungs-Vererbungsl.*, vol. 47, pp. 79-87.

HASEBE, K. 1918. Über das Hautleistensystem der Vola und Planta der Japaner und Aino. *Arb. Anat. Inst. d. Kaiserlich-Japanischen Univ. Sendai*, pp. 13-88.

HEINDL, R. 1927. System und Praxis der Daktyloskopie. Third ed. *Berlin and Leipzig*, W. de Gruyter & Co.

HENCKEL, K. O. 1933. Beiträge zur Anthropologie Chiles. I. Über die Papillarlinienmuster der Fingerbeeren bei der Bevölkerung der Provinz Concepcion. *Zeitschr. f. Morph. u. Anthrop.*, vol. 31, pp. 299-309.

———. 1934. Beiträge zur Anthropologie Chiles. III. Über die Papillarlinienmuster der Fingerbeeren bei Indianern der Provinz Cautin. *Zeitschr. f. Morph. u. Anthrop.*, vol. 34, pp. 113-119.

HEPBURN, D. 1893. The integumentary grooves on the palm of the hand and sole of the foot of man and the anthropoid apes. *J. Anat. and Physiol.*, vol. 27, pp. 112-130.

———. 1895. The papillary grooves on the hands and feet of monkeys and men. *Sci. Trans. Roy. Dublin Soc.*, vol. 5, pp. 525-538.

KEITH, H. H. MS. Study of right- and left-handedness. Unpublished thesis (1918); manuscript copy available through the courtesy of the author.

———. 1924. Racial differences in the papillary lines of the palm. *Am. J. Phys. Anthrop.*, vol. 7, pp. 165-206.

KIDD, W. 1907. The sense of touch in mammals and birds, with special reference to the papillary ridges. *London*, A. and C. Black.

KIRCHMAIR, H. 1934. Daktylographische Rassenmerkmale im Ambimanuar. *Zeitschr. f. Morph. u. Anthrop.*, vol. 33, pp. 49-70.

KLAATSCH, H. 1888. Zur Morphologie der Tastballen der Säugethiere. *Morph. Jahrb.*, vol. 14, pp. 407-435.

KOLLMANN, A. 1883. Der Tastapparat der Hand der menschlichen Rassen und der Affen in seiner Entwickelung und Gliederung. *Leipzig and Hamburg.*

———. 1885. Der Tastapparat des Fusses von Affe und Mensch. *Arch. f. Anat. u. Physiol., Anat. Abt.*, pp. 56-101.

KUBO, T. 1918. Beiträge zur Daktyloskopie der Koreaner. *Midd. med. Fachschule Keijo.*, vol. 2, pp. 117-223.

LECHE, S. M. 1933a. Dermatoglyphics and functional lateral dominance in Mexican Indians (Mayas and Tarahumaras). Pub. No. 5, *Middle American Research Series*, Tulane University, pp. 27-42.

———. 1933b. Handedness and bimanual dermatoglyphic differences. *Am. J. Anat.*, vol. 53, pp. 1-53.

———. 1936. Dermatoglyphics and functional lateral dominance in Mexican Indians. II. Aztecas. In *Measures of Men*, Pub. No. 7, *Middle American Research Series*, Tulane University, pp. 207-223.

MIDLO, C. 1934. Form of hand and foot in primates. *Am. J. Phys. Anthrop.*, vol. 19, pp. 337-389.

———, and H. CUMMINS. 1931. Dermatoglyphics in Eskimos. *Am. J. Phys. Anthrop.*, vol. 16, pp. 41-49.

MIYAKE, H. 1926. Über das Hautleistensystem der Vola der Koreaner. *Zeitschr. f. Morph. u. Anthrop.*, vol. 25, pp. 419-434.

MOLLISON, T. 1908. Rechts und Links in der Primatenreihe. *Korrbl. deutsch. Ges. Anthrop.*, vol. 39, pp. 112-115.

———. 1910-1911. Die Körperproportionen der Primaten. *Morph. Jahrb.*, vol. 42, pp. 79-304.

MONTGOMERY, R. B. 1926. Sole patterns. A study of the footprints of 2000 individuals. *Anat. Rec.*, vol. 33, pp. 107-114.

NEWMAN, H. H. 1934. Dermatoglyphics and the problem of handedness. *Am. J. Anat.*, vol. 55, pp. 277-322.

NEWMAN, M. T. 1936. A comparative study of finger prints and toe prints. HUMAN BIOLOGY, vol. 8, pp. 531-552.

PLOETZ-RADMANN, M. 1937. Die Hautleistenmuster der unteren beiden Fingerglieder der menschlichen Hand. *Zeitschr. f. Morph. u. Anthrop.*, vol. 36, pp. 281-310.

POLL, H. 1931. Das Manuar oder die Verteilung der Fingerleistenmuster bei verschiedenen Rassen. *Verhandl. d. Ges. f. Phys. Anthrop.*, vol. 5, pp. 49-59.

SCHAEUBLE, J. 1933. Die Entstehung der palmaren digitalen Triradien. *Zeitschr. f. Morph. u. Anthrop.*, vol. 31, pp. 403-438.

SCHLAGINHAUFEN, O. 1905. Das Hautleistensystem der Primatenplanta mit Berücksichtigung der Palma. *Morph. Jahrb.*, vol. 33, pp. 577-671, and vol. 34, pp. 1-125.

SCHULTZ, A. H. 1937. Fetal growth and development of the rhesus monkey. *Contr. to Embryol., Carnegie Inst. of Wash.*, vol. 26, pp. 71-97.

SHEAK, W. H. 1924. Some further observations on the chimpanzee. *J. Mammal.*, vol. 5.

STEGGERDA, M., I. D. STEGGERDA and M. S. LANE. 1936. A racial study of palmar dermatoglyphics with special reference to the Maya Indians of Yucatan. In *Measures of Men*, Pub. No. 7, *Middle American Research Series*, Tulane University, pp. 129-194.

TAKEYA, S. 1933. Ueber die Hautleistenfigur der Zehen der Chinesen. *J. Oriental Med.*, vol. 19, pp. 36-38.

———. 1934. Ueber die Hautleistenfigur der Planta der Chinesen. *J. Oriental Med.*, vol. 20, pp. 54-58.

VOLOTZKOY, M. V. 1936. On the genetics of finger prints. *Proc. Maxim Gorky Medico-Genetical Research Institute*, Moscow, vol. 4, pp. 404-439.

WILDER, H. H. 1897. On the disposition of the epidermic folds upon the palms and soles of Primates. *Anat. Anz.*, vol. 13, pp. 250-256.

———. 1922. Racial differences in palm and sole configuration. Palm and sole prints of Japanese and Chinese. *Am. J. Phys. Anthrop.*, vol. 5, pp. 143-206.

WHIPPLE, I. L. [Inez Whipple Wilder.] 1904. The ventral surface of the mammalian chiridium, with especial reference to the conditions found in man. *Zeitschr. f. Morph. u. Anthrop.*, vol. 7, pp. 261-368.

WILDER, I. W. 1930. The morphology of the palmar digital triradii and main lines. *J. Morph. and Phys.*, vol. 49, pp. 153-221.

YERKES, R. M., and A. W. YERKES. 1929. The Great Apes. *New Haven*, Yale University Press.

HOURLY PHYSIOLOGIC VARIATIONS IN PERIPHERAL HEMOGLOBIN, RED AND WHITE CELL COUNTS OF WOMEN: EFFECT OF PREGNANCY UPON BLOOD COUNTS

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INTRODUCTION

THIS study illustrates some of the concurrent physiological fluctuations of red blood cells, white blood cells, hemoglobin, and the differential white blood cell counts of 11 women who were observed hourly over a period of 13 consecutive hours, four of whom served as subjects on two separate occasions. In addition, the blood changes occurring in two women before conception and at weekly intervals thereafter from the third month to term are recorded. With the enlarging interests in a better understanding of the indices of physiological as well as pathological bodily activities (1-11) it seems worthwhile to present in full the carefully controlled and collected data[1] of the present study (12), not that it is sufficient alone to clarify any problem, but that it may be used to supplement similar reports now appearing in the literature.

It is common knowledge that a complete blood study is invaluable in the differential diagnosis of disease, but it is becoming increasingly evident that the biological state, as influenced by various external and internal physiological factors, may encroach upon the limits of the pathological. The border-line *becomes increasingly obscure,* then, thus necessitating a more precise investigation of the predominating influences which cause a physiological change in the blood and observation of possible diurnal rhythms.

[1] A preliminary report of this investigation was presented before the American Physiological Society in Chicago, 1929.

PROCEDURE

Subject. In these studies of the physiologic variations in the peripheral blood cell counts it has been necessary to standardize all procedures as completely as possible. The 11 subjects of the diurnal study, four of whom served for two periods, are active professional American women ranging in age between 22 and 37 years and have resided in Detroit for periods varying from eight months to several years. All observations were made by the same technician (F.K.) and during the inter-menstrual periods of the subjects. During the study an effort was made to protect Subjects V through XI from outside emotional disturbances and physical activity, which would effect the counts, and in addition, each individual recorded her emotional reactions (13) during the blood counts and any physical variations from the day's routine were noted, whereas Subjects I to IV were permitted to indulge in their usual activity.

The day's routine for the subject consisted of breakfast between 7:00 and 8:00 A.M., then the trip to the laboratory where she remained for the day. At 8:00 A.M. and every hour thereafter through 8:00 P.M., Subjects V through XI took only the few necessary steps about the small laboratory to have the blood count taken. The intervals between this physical activity were spent at the table reading, writing, or visiting. No restriction of physical activity was placed upon Subjects I to IV. All subjects with the exception of II and VIII had one recumbent or basal study made at the waking hour before arising from bed in the morning.

In addition to breakfast the subjects had their usual lunch and afternoon tea. Total food intake during the 12 hours was approximately 1100 calories. Liquid was ingested only at these three meal times: about 1000 grams were taken. In all cases, the evening dinner was delayed until after the conclusion of the final observations for the day.

One hundred and seventy days after the study was made upon Subject II she became pregnant. Ninety-nine days later the first of a series of 18 blood counts was made. These counts were made, for the most part, at weekly intervals. All of the determinations were made at approximately the same time of day, making it possible to compare each count throughout the 249 days of the study to the count made at the corresponding time during the daily study.

During a study of the nutritive state in the metabolism of pregnancy (14) blood counts upon an 18 year old primipara were obtained during

the final seven weeks of gestation and the first eight weeks of lactation.[2] This subject had a poor physical history and the blood counts were obtained in the customary clinical manner, no special attention being paid to the time of day or other technique. In themselves the figures obtained upon this girl are interesting: in comparison with Subject II of the diurnal study several significant conclusions may be drawn.

Technique. A free blood flow was established in the finger tips by an automatic spring lancet and the first blood exuding removed with dry sterile gauze sponges. The red and white cell pipettes, all of the Trenner automatic type and certified by the United States Bureau of Standards, and the 20 c.mm. hemoglobin pipette were filled from a fresh drop of blood in the sequence given. Four smears were then made under cover slips for the differential cell count. The same certified pipettes were used for each subject.

For the white count two per cent acetic acid was the diluent and for the red cell count, Hayem's solution. A Levy-Hausser certified counting chamber with the Neubauer ruling was used throughout all of the studies. The blood for hemoglobin was discharged into four cubic centimeters of distilled water, thoroughly rinsed in the water and allowed to stand one-half minute before four cubic centimeters of 0.2 N hydrochloric acid were added.

Four cover slip smears were made for each differential white cell count and two of the most suitable were chosen for staining. The usual Wright's stain and care in method were employed with the exception of the use of a buffered solution, instead of distilled water, as suggested by Feemster (15). The stains were mounted on slides with cedar oil or Canada Balsam. Two hundred white blood cells from each of two smears were counted, making a total of 400 cells for each hour.

In this study the following arbitrary classification of cells has been used: monocytes, lymphocytes, polymorphonuclears, eosinophiles and basophiles.

The Klett colorimeter with a Newcomber color disc (15) was used for the determination of hemoglobin and was frequently checked by the Van Slyke gasometric method. The dilutions, as described above, were

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[2] The cooperation of Dr. J. A. Johnston, Department of Pediatrics, Henry Ford Hospital, Detroit, made the study of this girl possible. The history is from the records of several years under his management and the blood counts were made at Henry Ford Hospital.

not read until they had stood 40 or more minutes. Three readings were made for each hemoglobin determination and their average recorded as the value for that hour.

EXPERIMENTAL DATA

White blood cell counts. Chart 1 illustrates the actual number of white cells per cubic millimeter of blood as well as the range of variation throughout the periods of observation in 11 subjects.

The curves of the four women who served for two studies are shown together and it may be noted that these pairs illustrate a closer resemblance than the curves for different individuals. On the whole the fluctuations are of approximately the same interval though the intensities may differ. This evidence substantiates the theory of an individual pattern and rhythm, the possibility of which has been suggested by several workers (5,6). Obviously the resemblance of the curves does not necessarily mean the same percentage of increase, as this may vary as much for one person as among individuals. In general, the maximum percentage of polymorphonuclears occurred in the count with the minimum percentage of lymphocytes and this was of course the percentage from examination of two different smears and 400 cells. Attention is called to the fact that each series shows a tendency to increase through the day and that the percentage of increase from the minimum to maximum count ranges from 39 to 154. These findings are in accord with those of Sabin (2) who found in six individuals a variation of approximately 100 per cent throughout an eight hour day with a periodic rhythm from peak to depression occurring at intervals of one to one and one-half hours. During our investigation, the larger group of women participated in very little physical activity which is in contrast to the activity entailed by the laboratory work of Sabin's subjects.

Low white cell counts in these curves approximate the recumbent observations charted in circles (Chart 1) and hence are representative of the so-called basal counts of Garrey and Butler (7). It seems justifiable then to state that these adults maintained a basal physical day. Additional evidence is found in the curves themselves. Subjects I through IV were permitted to indulge in their usual physical activity of professional life, such as rushing from class room to class room, climbing stairs and walking from building to building. The variations in the blood counts for some of these individuals were more exaggerated

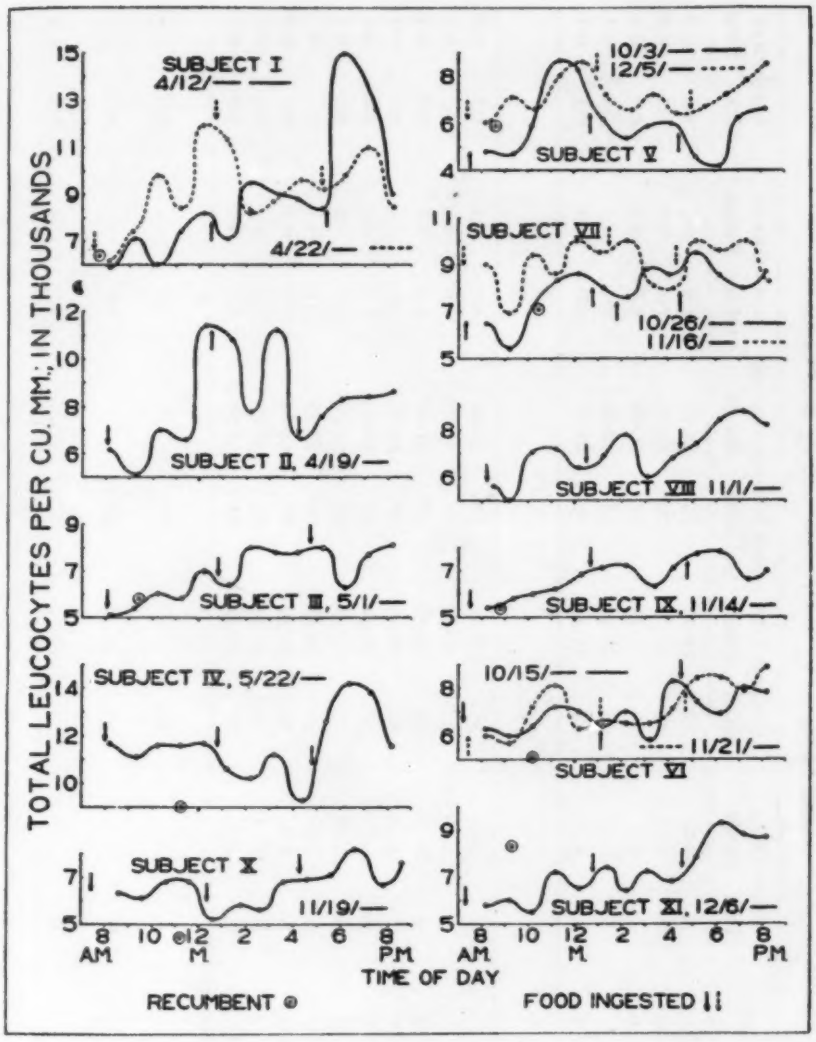


CHART I. THE ORDINATES SHOW TOTAL LEUCOCYTES PER C.MM. OF BLOOD AND THE ABSCISSAS, THE TIME

The circles in each curve represent the time at which the count was taken as well as the count itself.

TABLE 1. *Mean, range, and average mean of differential white blood count in 15 studies on 11 women* based on 13 consecutive hourly determinations*

ACTIVE SUBJECTS	STUDY	DATE	MONOCYTES		LYMPHOCYTES		POLYMORPHONUCLEARS		EOSINOPHILES		BASOPHILES	
			Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
I	a	4/12	5	2-8	19	12-26	74	69-77	1.6	0-4	0.8	0-2
	b	4/22	8	5-13	14	11-19	76	69-81	1.1	1-2	1.2	0-2
II	a	4/19	4	2-5	20	11-35	74	60-82	1.8	0-3	0.2	0-1
III	a	5/1	5	2-9	35	26-43	58	48-69	1.1	0-3	0.4	0-1
IV	a	5/22	4	1-7	25	21-33	70	61-77	0.8	0-1	0.3	0-1
INACTIVE SUBJECTS												
V	a	10/3	6	2-9	36	28-51	54	42-66	0.7	0-2	0.7	0-2
	b	12/5	5	3-9	32	28-36	62	57-66	0.8	0-2	0.7	0-1
VI	a	10/15	9	6-13	33	29-38	57	51-61	0.5	0-1	0.2	0-1
	b	11/21	7	4-10	32	26-40	60	51-66	0.4	0-1	0.8	0-1
VII	a	10/26	5	4-7	35	27-40	57	52-64	1.2	0-2	0.8	0-1
	b	11/16	6	4-10	33	21-38	59	52-70	2.0	1-4	0.7	0-1
VIII	a	11/1	6	3-9	30	24-36	64	59-71	0.2	0-1	0	0
IX	a	11/14	6	2-8	34	30-39	60	54-64	0.6	0-1	0.1	0-1
X	a	11/19	8	5-11	26	22-33	65	58-71	0.6	0-2	0.4	0-1
XI	a	12/6	5	4-7	30	24-38	63	56-70	0.7	0-1	0.9	0-1
Average of means for active subjects			5	...	23	....	70	....	1.3	...	0.6	...
Average of means for inactive subjects			6	...	32	....	60	....	0.8	...	0.5	...
Average of means for all subjects			6	...	29	....	64	....	0.9	...	0.5	...

* Two hundred cells from each of two smears (chosen from four) were counted making a total of 400 cells for each hour. Each mean and range is based upon a total count of 5200 cells.

CHART

RED CELLS IN MILLIONS PER CU. MM. BLOOD

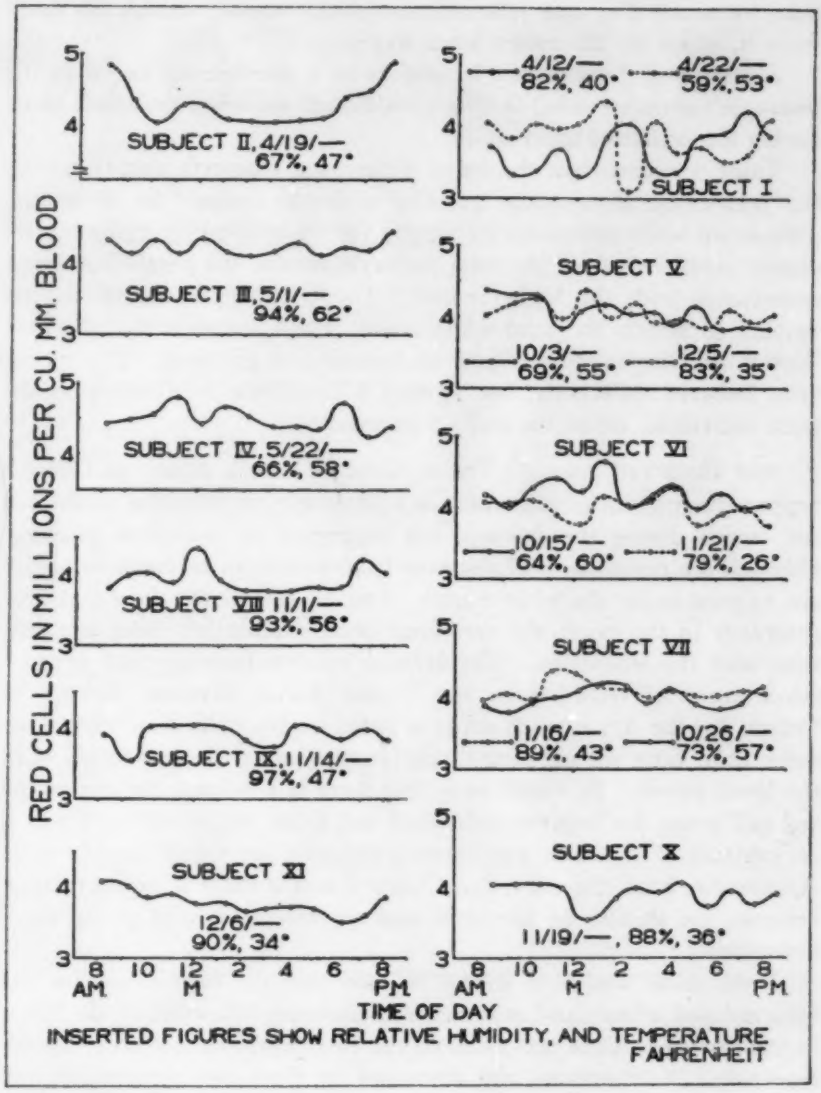

RED CELLS IN MILLIONS PER CU. MM. BLOOD
SUBJECT II, 4/19/— 67%, 47°
SUBJECT III, 5/1/— 94%, 62°
SUBJECT IV, 5/22/— 66%, 58°
SUBJECT VIII 11/1/— 93%, 56°
SUBJECT IX, 11/14/— 97%, 47°
SUBJECT XI 12/6/— 90%, 34°
4/12/— 82%, 40°
4/22/— 59%, 53°
SUBJECT I
SUBJECT V
10/3/— 69%, 55°
12/5/— 83%, 35°
SUBJECT VI
10/15/— 64%, 60°
11/21/— 79%, 26°
SUBJECT VII
11/16/— 89%, 43°
10/26/— 73%, 57°
SUBJECT X
11/19/—, 88%, 36°
8 AM 10 12 M 2 4 6 8 PM
TIME OF DAY
INSERTED FIGURES SHOW RELATIVE HUMIDITY, AND TEMPERATURE FAHRENHEIT

CHART 2. ERYTHROCYTE COUNTS AS TAKEN ONCE EVERY HOUR ON ELEVEN SUBJECTS AND THE CIRCLES WITHIN EACH CURVE REPRESENT THE EXACT TIME AND THE COUNT FOR THAT TIME

than for succeeding ones who refrained from activity outside the small room in which the laboratory work was done.

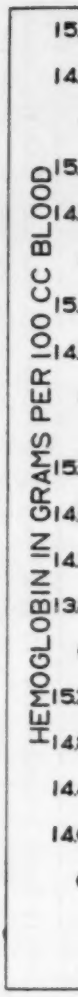
Ingestion of food cannot be said to be a determinant factor in the leucocyte curves recorded in Chart 1 although no heavy meal was taken during the period of observation.

Table 1 summarizes the mean differential leucocyte counts for all the periods of observation, together with the range. In all of the differential white cell counts the figures for the total polymorphonuclears closely parallel those of the total leucocyte counts, the parallelism being accentuated with the higher count. The lymphocytic curves do not parallel so closely the total white count, which suggests that the production of lymphocytes follows an independent gradient. The monocytes behaved differently, but showed a significant relationship in the same individual, where the study was repeated .

Red blood cell counts. The erythrocyte curves shown in Chart 2 support the contention that there is a physiological variation in the red cell counts during the day and are suggestive of individual patterns, although the percentages of increase from minimum to maximum were not so great as for the white counts. The red cell counts show a greater constancy in the blood, the variations being smaller but more frequent than with the leucocytes. The average relative humidity and average temperature as recorded by the United States Weather Bureau in Detroit for the day of each study is noted on the individual curves but there have been no significant relationships noted in connection with the blood counts. It would seem that there is a definite rhythm in the red cell count for a given individual but from the curves in Chart 2 no evidence of a similar trend among different individuals can be seen. Apparently, from the curves in Charts 1 and 2 there is no correlation between the rhythm of leucocyte and erythrocyte counts in the same individual.

From these studies it cannot be said that the high count for the total red and white blood cells depends upon concentration of the blood in the periphery since the peaks of the two curves do not occur simultaneously. Furthermore, the decreases in these two counts are not consistent with the small liquid intake.

Chart 3 shows the curves for the hemoglobin determinations upon each of the 11 women. As in the charts for white and red blood cell counts the curves for the four women upon whom the study was repeated show an individual similarity. However, from the three charts



CHART

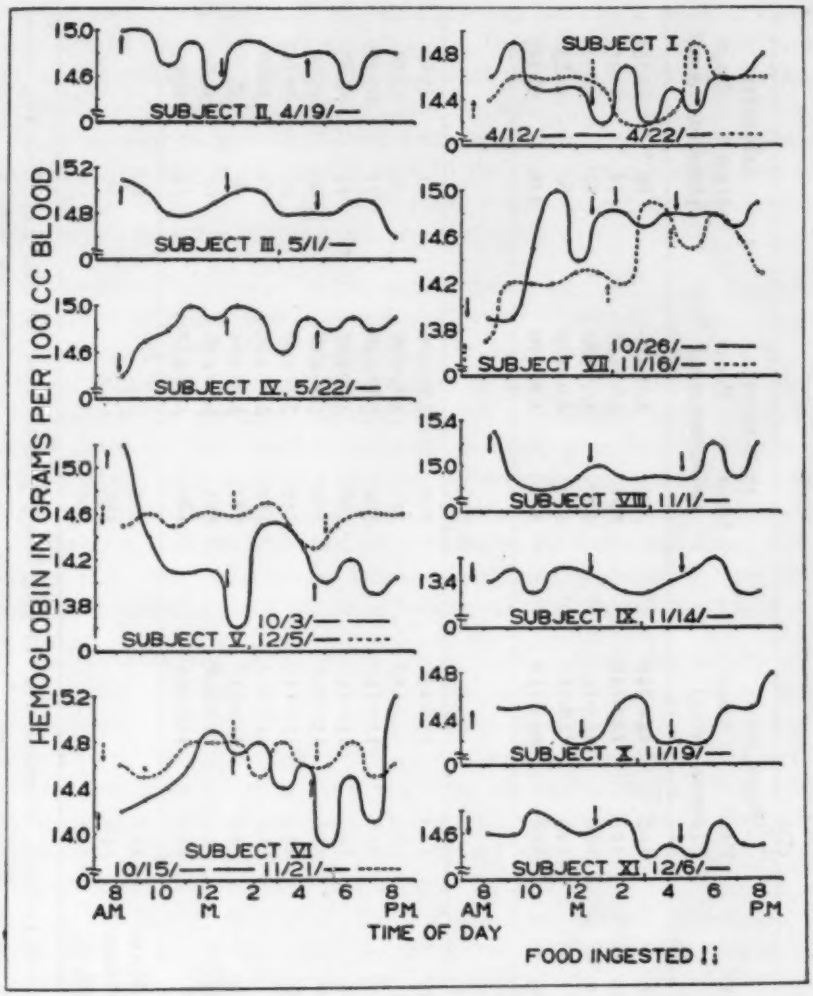


CHART 3. HOURLY HEMOGLOBIN DETERMINATIONS ON THE ELEVEN WOMEN DURING THE 15 DIURNAL STUDIES

there does not appear to be any consistency in rise and fall of hemoglobin with either the red or white cell counts. From the determinations it appears that, though these women were not conscious of any deficiency, they had a lower hemoglobin than is generally considered optimal for bouyant health. Study of the curves in Chart 3 supports the con-

TABLE 2. *Mean, range, and average mean of total blood counts in 15 studies on 11 women based on 13 consecutive hourly determinations*

ACTIVE SUBJECTS	STUDY	DATE	HEMOGLOBIN Mean (grams/100 cc.)	HEMOGLOBIN Range (grams/100 cc.)	ERYTHROCYTES Mean (millions/c.mm.)	ERYTHROCYTES Range (millions/c.mm.)	LEUCOCYTE* Mean (hundreds/c.mm.)	LEUCOCYTE* Range (hundreds/c.mm.)
I	a	4/12	14.5	14.2-14.9	3.79	3.31-4.22	89	59-151
	b	4/22	14.5	14.2-14.9	3.91	3.51-4.36	91	61-118
II	a	4/19	14.8	14.5-15.0	4.30	4.03-4.87	82	56-113
III	a	5/1	14.9	14.6-15.1	4.26	4.10-4.69	69	47-83
IV	a	5/22	14.8	14.4-15.0	4.50	4.30-4.79	116	96-145
INACTIVE SUBJECTS								
V	a	10/3	14.4	13.6-15.2	3.99	3.66-4.26	61	45-87
	b	12/5	14.3	14.3-14.7	4.06	3.84-4.36	73	63-88
VI	a	10/15	14.6	13.9-15.2	4.04	3.87-4.28	71	60-88
	b	11/21	14.6	14.5-14.8	3.98	3.75-4.27	73	54-85
VII	a	10/26	14.5	13.9-15.0	3.99	3.68-4.08	80	55-94
	b	11/16	14.4	13.7-14.9	4.09	3.95-4.36	92	70-105
VIII	a	11/1	14.9	14.8-15.3	3.87	3.66-4.24	71	50-86
IX	a	11/14	13.4	13.3-13.6	3.83	3.60-4.04	68	53-78
X	a	11/19	14.4	14.2-14.8	3.93	3.69-4.08	67	54-81
XI	a	12/6	14.5	14.4-14.8	3.80	3.54-4.12	73	55-94
Average of means for active subjects			14.7	.....	4.15	.....	89	....
Average of means for inactive subjects			14.0	.....	3.96	.....	73	....
Average of means for all subjects....			14.5	.....	4.02	.....	78	....

* The ranges and means are from 13 hourly determinations. In each hourly determination 200 cells each from two smears (picked from 4 taken) were used for the differential count; the means and ranges for hemoglobin are from the average of 3 readings for each hour; the mean and range figures for erythrocytes are based upon the average of two counts per hour.

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clusions of Duckles and Elvehjem (11) that there is a definite diurnal rhythm of hemoglobin concentration. The figures in this study, of course, represent conditions in the region of Detroit and may be considered representative of professional women.

Mean and range counts have been determined for the hemoglobin, erythrocytes and leucocytes for each of the 15 periods of study and are shown in Table 2. In all cases these measures are greater for the leucocytes than for erythrocytes and hemoglobin.

Emotional reactions. It has been demonstrated (16) that emotional disturbances affect both the red and white blood cell counts, consequently certain emotional reactions were recorded by Subjects V to XI in an attempt to secure an indication of the general emotional trend throughout the period of observation. A quantitative scale which has been developed and used successfully in other physiological studies in these laboratories was used to classify the emotional states (15). According to the data obtained, over 75 per cent of the records fall on the optimum side of the scale and 10 per cent on the depressed side. There were only two instances in which intense worry occurred, one of a dejected feeling, two of excessive listlessness, and, five of great fatigue.

Determinations during pregnancy. Table 3 gives the results of a blood study upon two women during pregnancy. Subject 1 in the table is Subject II of the eleven women in the diurnal study. Subject 2 is the 18 year old primipara. For comparison, in the case of Subject 1, the corresponding counts are given from the earlier study. Nine blood counts were made upon Subject 2 during the eight weeks following delivery. The changes during this period show the remainder of the complete cycle throughout pregnancy.

If the hemoglobin values for Subject 1 are plotted statistically by the method of "mean squares" the curve is a gradually descending straight line. While the figures obtained at the corresponding time during the diurnal study show a rather high value for hemoglobin compared to the red cell count, this is probably due to individual characteristic rather than error in counting. The white count is the average of counts of 400 cells and the hemoglobin is the result of the average of three readings. The white cell counts are not particularly significant for the variations are all within the range of probable error. A decided drop is apparent in the red count from the pre-pregnancy value but the values during pregnancy are within the range of error.

readings for each hour; the mean and range figures for erythrocytes are based upon the average of two counts per hour.

TABLE 3. *Effect of pregnancy upon the blood counts of two subjects**

DAYS		TIME (a.m.)	HEMOGLOBIN (grams/100 cc.)		ERYTHROCYTES (millions/c.mm.)		LEUCOCYTES (hundreds/c.mm.)		POLYMORPHONUCLEARS (per cent)	
Subject		Subject	Subject		Subject		Subject		Subject	
1	2	1	1	2	1	2	1	2	1	2
Before pregnancy:										
171	...	9:10	15.0	...	4.35	...	51	...	73	..
Term:										
99	...	9:15	13.2	...	3.36	...	71	...	77	..
106	...	9:25	12.9	...	3.61	...	68	...	75	..
113	...	10:55	12.5	...	3.24	...	54	...	76	..
120	...	9:20	12.8	...	3.28	...	62	...	81	..
127	...	9:30	12.4	...	3.39	...	70	...	79	..
134	...	9:20	13.0	...	3.37	...	67	...	76	..
141	...	9:20	12.6	...	3.09	...	62	...	81	..
148	...	9:10	12.1	...	3.16	...	64	...	76	..
155	...	9:20	12.8	...	3.24	...	58	...	79	..
162	...	9:35	12.2	...	3.29	...	56	...	79	..
176	...	9:25	12.9	...	3.14	...	68	...	76	..
183	...	9:35	12.1	...	3.54	...	54	...	73	..
190	...	9:40	12.4	...	3.32	...	66	...	77	..
204	...	9:30	12.4	...	3.51	...	70	...	77	..
...	218	....	...	...	...	3.05	..	88	..	..

TABLE 3 (*Continued*)

TABLE 3 (*Continued*)

...	222	....	...	9.0	...	2.93	..	...	..	..
225	...	9:20	12.8	...	3.27	...	66	...	79	..
...	228	....	...	9.6	...	3.06	..	59	..	73
232	...	9:45	none	...	3.49	...	72	...	none	..
...	236	....	...	11.4	...	2.74	..	69	..	75
239	...	9:30	none	...	3.36	...	68	...	none	..
...	245	....	...	8.5	...	3.30	..	62	..	72
249	...	10:15	11.7	...	3.32	...	60	...	75	..
...	257	....	...	10.9	...	3.51	..	69	..	67
...	268	....	...	10.2	...	...	..	72	..	70
...	270	Delivery								
Post-partum :**										
...	2	....	...	9.4	...	3.96	..	111	..	79
...	5	....	...	9.1	...	2.60	..	140	..	81
...	8	....	...	10.9	...	3.76	..	126	..	91
...	11	....	...	11.1	...	4.40	..	72	..	58
...	15	....	...	11.6	...	3.57	..	66	..	66
...	23	....	...	11.0	...	3.96	..	39	..	65
...	32	....	...	12.4	...	4.04	..	50	..	59
...	46	....	...	13.0	...	4.20	..	52	..	..
...	57	....	...	12.8	...	4.50	..	66	..	74

* Subject 1 is Subject II of the diurnal study. Subject 2 is the 18 year old primipara.

** Delivery of Subject 1 was June—Subject 2 in May. The pregnancies, therefore, may be compared without regard for any possibility of seasonal effect.

Subject 2, notwithstanding the poor nutritional history and the fact that the counts were made at various times during the day, presents a similar picture during comparative stages of pregnancy. The greater irregularity of the counts for Subject 2 may be attributed to the variation in the time of day at which the counts were made. Because of the possibility of diurnal tides in the leucocyte and hemoglobin content of the blood it would seem that when blood determinations are made under conditions which are not standardized the normal physiological variation should be considered in the estimation of the clinical significance of the results.

Although the hemoglobin of Subject 2 was consistently too low to be compatible with healthful living it is interesting to mark the rapid leveling process after delivery. On the eleventh day postpartum the red count had appreciated and the white count diminished to near normal. In the same time the hemoglobin rose over eighteen per cent.

The results of this study appear to confirm, in part, McIlroy's statement: "A certain degree of increase in blood volume associated with watery dilution of the blood or hydremia takes place in pregnancy. The percentages of haemoglobin, red blood corpuscles and salts therefore are relatively decreased.... There is a slight degree of leucocytosis in pregnancy" (17).

The latter part of this statement, however, is not in accord with the record of Subject 2. The high white count after delivery of the primipara is more in accord with Beck's report: "In the latter part of pregnancy and particularly during labor the number of leukocytes is increased. A white count of 15,000 to 20,000 before, during, and after labor is common. The change in blood volume is accompanied by a relatively diminished red blood count and a lowering of the hemoglobin" (18).

It is impossible to reconcile the statement of Curtis with the counts in these two cases. In 1933 he wrote,

> In the later months of pregnancy the bone marrow apparently becomes hyperactive. The reticulated erythrocytes increase, yet fail to bring the blood count back to normal. As a constant concomitant of pregnancy, there occurs a slight rise of the leucocyte count at term, which becomes distinctly accentuated under the stress of labor.
>
> The leukocytes are little changed early but rise steadily during the course of pregnancy, to reach a slightly elevated plane anterpartum (19).

The results of this investigation upon healthy young women are similar to those of a study by this laboratory of 1,644 simultaneous determinations of hemoglobin, red blood cell, and white blood cell counts made upon 364 well infants during their first year of life (20). During this infant blood count study the infants were subject to a carefully supervised dietary regimen. Statistical presentation in the infant study established, mathematically, the precept that quantitatively the hemoglobin, the red blood cell, and the white blood cell counts are independent of one another within certain limits, a knowledge of one being of little value in estimating another.

SUMMARY AND CONCLUSIONS

Fifteen hourly studies of the blood of eleven healthy young professional women were made to determine any physiological diurnal variations. Blood samples were taken every hour from 8:00 A.M. through 8:00 P.M. Two red cell counts each hour necessitated a total of 390 determinations. Three hemoglobin readings each hour totaled 585. Seventy-eight thousand white cells were counted, 400 from each hourly sample. Four subjects were active during the study — the other seven were protected from emotional disturbances and physical activity.

The data obtained indicated that there is a physiological variation in the blood count from hour to hour during the day; that the variation is different for each individual but is similar from day to day for a given person; and, that there is no correlation, even in the same individual, between the variations in hemoglobin and the red and white cell counts. In the differential counts the proportion of polymorphonuclears remains constant with the total white count; the percentage of lymphocytes varies.

Emotional reactions during the counts, physical variations in the day's routine, and food and liquid intake during the study were considered. The results of the study indicate that considerable physical activity or emotion produces increased blood counts.

The average of the means obtained from the 15 diurnal studies results in a figure which is a near-normal for young professional women of this area. It is evident that, in any clinical estimation or adaptation of blood counts, the normal physiological variations should be considered.

Nine months after the diurnal study upon one subject the first of a series of 18 blood counts, between 99 and 249 days of the term of her

pregnancy, was made. These counts, made at the same time of day, are compared to the corresponding count in the diurnal study.

Blood counts were made upon the blood of an 18 year old primipara during the final 53 days of pregnancy and first 57 days postpartum. The pregnancy counts are compared to those of the subject from the diurnal study at stages in gestation which are within a few days of each other.

While additional information concerning the effect of pregnancy upon the blood determinations would produce more authoritative data, the study of these two subjects indicates that conception produces lowered hemoglobin values and red cell counts and a slightly higher white cell count, within a short time. This condition remains fairly constant throughout pregnancy. Near the time of delivery the white count increases and the hemoglobin is lowered but within a few days postpartum a rapid return toward non-pregnant values is started.

BIBLIOGRAPHY

1. Cannon, W. B. Bodily Changes in Pain, Hunger, Fear and Rage. D. Appleton and Co., *New York*, 1920.
2. Sabin, F. R., R. S. Cunningham, C. A. Doan and J. A. Kindwall. Normal rhythm of the white blood cells. *Bull. Johns Hopkins Hospital*, 37:14, 1925.
3. Mora, J. M., L. E. Amtman, and S. J. Hoffman. Effect of mental and emotional states on leukocyte count. *J.A.M.A.*, 86:945, 1926.
4. Doan, Charles A., and L. G. Zerfas. Rhythmic range of the white blood cells in human, pathological leucopenic and leucocytic states, with a study of thirty-two human bone marrows. *J. Exp. Med.*, 46:511, 1927.
5. Medlar, E. M. The extent of the variations in the leukocytes of normal individuals. *Am. J. Med. Sci.*, 177:72, 1929.
6. Smith, C., and A. M. McDowell. Normal rhythm of white blood cells in women. *Arch. Int. Med.*, 43:68, 1929.
7. Garrey, W. E., and V. Butler. Physiological leucocytosis. 13th International Physiol. Congress, Aug., 1929.
8. Wintrobe, M. M. Erythrocyte in man. *Medicine*, 9:195, 1930.
9. Short, J. J. Diurnal variations in concentration of red blood cells and hemoglobin. *J. Lab. Clin. Med.*, 20:708, 1935.
10. Ponder, E., G. Saslow, and M. Schweizer. Variations in the white-cell count of man. *Quart. J. Exp. Physiol.*, 21:21, 1931.
11. Duckles, D., and C. A. Elvehjem. Hemoglobin studies on college women with special reference to the effect of menstruation. *J. Lab. Clin. Med.*, 22:607, 1937.
12. Kenyon, F., and I. G. Macy. Some physiological variations in peripheral blood cell counts. *Am. J. Physiol.*, 93:663, 1930.

13. HUNSCHER, H. A., E. L. VINCENT, and I. G. MACY. Psychophysiological studies: The technique of securing quantitative and coordinated psychological and physiological data on lactating women in their usual home environment. *Child Development*, 1:15, 1930.

14. HUMMEL, FRANCES COPE, HELEN A. HUNSCHER, MARY F. BATES, PRISCILLA BONNER, and ICIE G. MACY. Consideration of the nutritive state in the metabolism of women during pregnancy. *J. Nutrition*, 13:263, 1937.

15. FEEMSTER, R. F. Study of variable factors in the use of Wright's stain. *Annals of Int. Med.*, 2:289, 1928.

16. NEWCOMER, H. S. A new optical instrument for the determination of hemoglobin. *J. Biol. Chem.*, 55:569, 1923.

17. MCILROY, *Dame* LOUISE. Toxaemias of Pregnancy. William Wood and Co., *Baltimore*, 1936.

18. BECK, ALFRED C. Obstetrical Practice. Williams and Wilkins Co., *Baltimore*, 1935.

19. CURTIS, ARTHUR HALE. Obstetrics and Gynecology. W. B. Saunders Co., *Philadelphia*, 1933.

20. HAMIL, B. M., M. W. POOLE, BETTY MUNDAY, MARION L. SHEPHERD, LOUISE EMERSON, and ICIE G. MACY; and T. E. RAIFORD. A consideration of quantitative relations between erythrocytes, leucocytes, and hemoglobin of the blood. *J. Lab. Clin. Med.*, 23:488, 1938.

INTERRELATIONS OF HEMOGLOBIN, BASAL METABOLISM, AND CREATINE, CREATININE AND MAGNESIUM EXCRETION DURING HUMAN PREGNANCY

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I. PROBLEM, BACKGROUND, AND DATA

IN A preceding paper (7), Seegers and Potgieter discussed the variability of creatine and creatinine excretion for a group of young women who, to all appearances, were quite normal and healthy throughout pregnancy. They found without exception that their daily creatine excretion was more variable than the creatinine output, and concluded that creatine formation was probably associated with a less stable metabolic mechanism than creatinine.

In the same report they also discussed the relationship between protein ingestion and creatine and creatinine output. No significant effects, directly attributable to the quantity of protein in the food, were found. Further analysis of data for these women which are now on file at the Institute shows that ingested fat and base have a similar low correlation with creatine or creatinine excretion. Likewise nitrogen, fat, or base retention were not closely associated with the qantities of each of these metabolites excreted in the urine.

In Table 3 in their discussion, Seegers and Potgieter showed that the correlations between protein (nitrogen) ingestion and both creatine and creatinine excretion were similar for subjects III-b, VI, and X. Their periodic balance studies had been begun in the second month of pregnancy. They were observed at short, frequent intervals until term and re-tested for base and nitrogen utilization at one year post-partum. The ingestion was similar for all tests for a given individual. To all appearances their infants have had quite normal developmental histories

during the first three years, infant VI having been slightly accelerated in skeletal development from birth.

Detailed examination of the protocols show that these women tended to store low levels of protein and mineral although the quantities ingested were theoretically adequate (7). They tended toward negative basal metabolism values (Table 1), and toward levels of hemoglobin bordering on aenemic states. In addition, the unusually low correlation between maternal weight and stage in pregnancy suggested that fetal growth may have been accompanied by simultaneous reduction in maternal weight.

Data for two other subjects whose general metabolism resembled these three have since been analyzed. The findings for the group are given in Table 1. Subjects III and X were treated for mild thyroid deficiency. Subject VIII and subject VI suffered each year from hay fever, and subject VIII was also somewhat asthmatic. The metabolism of these two women was particularly interesting because their infants were born on the same day, and their dietary choices were similar with respect to protein intake. Each was treated intermittently for aenemia.

Subject VII tended more toward positive metabolic balance than did the other four. She moved from the village before a post-partum examination could be made, but the records which are available show that she fluctuated around ±0 percent basal metabolic rate just prior to this pregnancy. During the last two months of gestation she had intermittent mild albuminurea and was diagnosed as somewhat aenemic during a preceding pregnancy as well. As shown previously (7) she had the lowest level of protein ingestion of the group, since an attempt was made to control the albuminurea by removing some proteins from her diet.

It was apparent from the findings of Seegers and Potgieter and from our further studies on fat and mineral metabolism that in certain ways the findings did not differ greatly from fairly well established metabolic principles for normal pregnant individuals. As will be seen later, their total nitrogen metabolism seemed to proceed in a fairly normal manner. Our unpublished data on their potassium and sodium metabolism show that within the limits of individual difference they seemed to be utilizing these bases in normal ratios. They stored low levels of calcium and their magnesium retention was erratic.

It occurred to us that there might be some association between the particular metabolic features which differed from accepted values most

TABLE 1

Levels of hemoglobin, urinary creatine, creatinine, nitrogen and magnesium, basal metabolism and weight

SUBJECT	DAYS PRE-DELIVERY	HEMO-GLOBIN	BASAL WEIGHT	BASAL METABOLISM	URINARY		URINARY	
		(percent Newc.)	*(pounds)*	*(percent)*	Creatine *(grams per day)*	Creatinine *(grams per day)*	Magnesium *(milli-equivalents)*	Nitrogen *(milli-equivalents)*
III '34.....	196	78	136	0	0.43	1.50	17.43	2994
	168	74	139	8	0.73	1.48	20.15	2879
	140	66	143	6	0.35	1.37	17.19	2797
	84	68	148	8	0.56	1.52	15.38	2141
	49	64	151	3	0.40	1.56	9.70	1915
	10	68	159	7	0.89	1.42	10.44	2028
	*	83	138	11	0.25	1.21	9.95	2195
VI	132	77	111	3	1.26	0.76	12.91	2279
	97	68	119	1	0.74	0.78	13.65	2478
	76	67	123	5	0.72	0.84	10.94	2118
	48	68	127	6	1.16	0.96	19.16	2151
	*	77	111	16	0.56	0.74	16.61	1811

TABLE I (*Continued*)

VII	75	58	127	2	0.92	1.17	13.40	2259
	46	62	138	11	0.90	1.33	9.05	2051
	5	62	145	15	0.58	1.24	6.83	1750
VIII	84	67	146	2	0.91	0.99	12.66	1715
	56	67	147	5	0.44	1.39	7.57	1622
	27	69	150	5	0.23	1.39	9.95	1540
	3	57	148	5	0.50	1.25	8.63	1573
	*	89	130	17	0.16	1.35	12.83	2071
X	238	68	148	0	0.10	1.37	8.06	2457
	210	71	145	10	0.55	1.54	8.39	2579
	182	67	151	0	0.08	1.70	9.79	2568
	155	69	160	5	0.83	1.53	15.87	2320
	98	63	171	5	0.70	1.70	11.10	2371
	69	63	172	3	0.50	1.47	10.12	1985
	42	59	174	1	0.53	1.68	9.54	2255
	*	74	144	19	...	...	....	....

* Test made 365 days after delivery.

widely. Those items were therefore studied further in respect to total protein metabolism, basal metabolism, and weight and in respect to each other to see whether the variable metabolic features have some trends in common.

The data included in Table 1 were collected during three day observation periods. The detailed description of the subjects and the analytical procedures has been given previously (5) (7).

II. RELATIONSHIPS TO STAGE IN PREGNANCY

The variation with stage in pregnancy was first computed to see what the effects of fetal growth and maternal tissue change might be.

Correlation between stage in pregnancy and:	r
Urinary magnesium	$-.29\pm.13$
Urinary creatine	$+.27\pm.13$
Urinary creatinine	$-.19\pm.13$
Urinary nitrogen	$-.79\pm.05$
Hemoglobin level	$-.63\pm.09$
Oxygen consumption	$+.40\pm.09$
Weight gain	$+.13\pm.14$

From the correlation, one can infer that there was not much individual difference in nitrogen excretion. The protein intake was quantitatively similar for four of the subjects (7). Since the urinary nitrogen varied quite consistently with fetal growth, it would seem that creatine and creatinine metabolism therefore was less stable than protein metabolism measured in terms of excretion levels.

The total weight gain for each subject was within normal limits, but because each individual controlled her gain as much as possible during the last two months of pregnancy the gains were slight at times. The correlation is therefore somewhat spurious although the raw data indicate that a certain type of gain was not peculiar to a given stage in pregnancy. The level of oxygen consumption which of course depends upon the mass was more closely related to stage in pregnancy than the change in weight itself.

There was a tendency toward lower hemoglobin values as term approached. This tendency, although it is slight, is nevertheless different from the normal trend in hemoglobin formation. The usual curve for pregnancy shows that the minimum level is reached about the sixth or seventh fetal month, followed by a slight rise until delivery. The variation in our values, since it is slight, may be due to sampling. However,

the trend toward continued reduction seems to be associated with other trends, such as reduced gain in weight, and suggests some metabolic strain.

III. RELATIONSHIP OF CREATINE AND CREATININE TO THE OTHER FACTORS

In two recent studies Catherwood and Stearns (1) and Wang (8) discussed the relationships between creatine and creatinine formation and excretion, weight gain and basal metabolism during infancy and childhood. Each found that creatine and creatinine excretion increased as weight increased. Catherwood and Stearns concluded that thyroid activity may be the principal factor concerned in determining the quantity of creatine excreted during infancy. In newborns creatinine excretion seemed to depend solely upon quantity of musculature, it being either independent of, or constant toward, exogenous factors. They concluded that excretion of creatine on the other hand was governed by a different phase of muscle metabolism both at birth and during the early period of postnatal growth. Simultaneously, Wang (8) found that at older age levels preformed creatinine likewise increased with increase in basal metabolism.

Thus, Seegers and Potgieter, Catherwood and Stearns, and Wang each find that under normal conditions creatine and creatinine are rarely excreted in constant proportions at the stages in human growth which they have investigated.

Product-moment coefficients of correlation were next computed between creatine and creatinine and each of the following: oxygen consumption, hemoglobin, weight, urinary nitrogen, and urinary magnesium. The results are indicated by r_1. Next r_2 was computed, which represents the same relationship with stage in pregnancy held constant. The results are as follows:

	r_1	r_2
Creatine and oxygen consumption	−.05±.14	−.19±.14
Creatinine and oxygen consumption	+.23±.13	+.34±.12
Creatine and hemoglobin	−.14±.14	+.04±.14
Creatinine and hemoglobin	−.17±.14	−.38±.12
Creatine and weight	−.43±.09	−.49±.09
Creatinine and weight	+.80±.06	+.85±.06
Creatine and urinary nitrogen	−.06±.14	+.24±.13
Creatinine and urinary nitrogen	+.19±.14	+.07±.14
Creatine and urinary magnesium	+.37±.12	+.48±.09
Creatinine and urinary magnesium	−.15±.14	−.22±.13
Creatine and creatinine	−.58±.09	−.56±.09

The correlation between creatine and creatinine was not affected by stage in pregnancy. The coefficient is greater than that reported by Seegers and Potgieter (7), probably due to more uniform data. Each is most closely related to weight, although they differ both in trend and degree of relationship with it. The excretion of creatine decreased as maternal weight increased, while creatinine correlated quite closely with it.

Creatine excretion and magnesium excretion in the urine vary together slightly, a point of interest being the similarity between this r and that for creatine and creatinine themselves.

Apparently creatine excretion is not related to level of oxygen consumption in these subjects.

IV. RELATION OF HEMOGLOBIN TO THE OTHER FACTORS

The experimental evidence about relationships of hemoglobin levels and rate of oxygen consumption is not extensive. Remington (6) found that hemoglobin levels vary with changes in basal metabolism in cases of mild hypothyroidism in young white and negro women. Fluctuations in hemoglobin itself during human pregnancy have, of course, been studied extensively, and decrease in its level at some stages where basal metabolism is increasing is characteristic for apparently healthy women during gestation.

In respect to the association of hemoglobin and magnesium, Greenberg and his co-workers (3) found considerably more magnesium in the red corpuscles than in the plasma and concluded that the magnesium content of serum and plasma are independent of each other. Eveleth (2) confirmed this finding for animals of various species. Henderson and Greenberg (4) recently extended these studies on base distribution and found that 80 per cent of the base in the blood is held by the hemoglobin, the latter in itself being about 50 per cent saturated by alkali.

The correlations are as follows:

	r_1	r_2
Hemoglobin and urinary magnesium.....	+.54±.09	+.98±.05
Hemoglobin and oxygen consumption.....	−.46±.09	−.30±.12
Hemoglobin and weight.....	−.31±.14	−.30±.12
Hemoglobin and urinary nitrogen.....	+.55±.09	+.01±.14

Hemoglobin and urinary magnesium varied together, being influenced by stage in pregnancy. We know of no physiological explanation for the existance of a close relationship between them. The apparent

dependent relationship between hemoglobin and urinary nitrogen is an artifact since when stage in pregnancy is held constant the r is reduced to $+.01 \pm .14$.

V. INTERRELATIONS OF HEMOGLOBIN, URINARY MAGNESIUM, AND CREATINE

It was seen that creatine and magnesium excretion varied together a little, and that hemoglobin and magnesium varied together to a fair degree.

Creatine levels had little effect upon the size of the r between hemoglobin and magnesium. The r changed from $+.54$ to $+.64$ when creatine was held constant.

When the rate of oxygen consumption is included in a multiple correlation with hemoglobin, urinary magnesium and creatine, the R continued to approach 1.0 ($R = .71$). A similar calculation, substituting creatinine for creatine indicated that it was an independent variable with respect to the other three metabolites.

VI. DISCUSSION AND SUMMARY

In computing these correlations, the possible effect of very limited sampling is recognized. Therefore, chemical linkages should in no way be inferred until much greater samplings are made.

There is some additional evidence that the theory postulated by Seegers and Potgieter in regard to creatine metabolism is correct. When some of the physiologically heterogeneous phases of their sampling were ruled out by grouping the subjects according to some common metabolic tendencies, the correlation between creatine and creatinine is raised to a figure more similar to previous findings.

Tendencies common to the group studied were:

(a) Low levels of base and nitrogen retention on average levels of ingestion.
(b) A tendency toward negative basal metabolic rate.
(c) A tendency toward low levels of hemoglobin.
(d) Controlled weight gain during pregnancy.

To summarize: Twenty-four hour samplings of nitrogen, creatine, and creatinine and magnesium excreted simultaneously in the urine were

studied together with hemoglobin, oxygen consumption and weight determined under basal conditions the next morning.

Hemoglobin, urinary magnesium and creatine tended to vary together, depending very slightly upon the simultaneous rate of oxygen consumption per minute.

Creatine and creatinine were again seen to differ with respect to body weight, in this case during human pregnancy.

REFERENCES

1. CATHERWOOD, RUTH AND STEARNS, GENEVIEVE. Creatine and creatinine excretion in infancy. *J. Biol. Chem.*, 1937, 119, 201-214.
2. EVELETH, D. F. Comparison of the distribution of magnesium in blood cells and plasma of animals. *J. Biol. Chem.*, 1937, 119, 289-292.
3. GREENBERG, D. M., SALVATORE, P. L., MACKEY, M. A., AND TUFTS, E. V. The magnesium content of the plasma and the red corpuscles in the human blood. *J. Biol. Chem.*, 1933, 100, 139-148.
4. HENDERSON, Y. AND GREENBERG, L. A. Hemoglobin and alkali in the blood. *Am. J. Physiol.*, 1937, 9, 332-333.
5. HUFF, C. E., AND PYLE, S. I. Differences in the utilization of calcium and phosphorus in negative and positive balances during pregnancy. HUMAN BIOL., 1937, 9, 29-41.
6. REMINGTON, R. E. Blood hemoglobin in thyroid enlargement. *J. Biol. Chem.*, 1931, 92, lxxix.
7. SEEGERS, W. H. AND POTGIETER, M. The quantity of creatine and creatinine excreted in normal human pregnancy. HUMAN BIOL., 1937, 9, 404-409.
8. WANG, C. C. Basal metabolism, preformed and total creatinine nitrogen in twenty-four boys and forty-six girls between one month and fifteen years of age. *J. Biol. Chem.*, 1937, 119, cii.

THE EFFECT OF THE WAR YEARS UPON MORTALITY IN CHILDHOOD

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THE present desire for a 'physically fit' nation has given rise to many expressions of opinion upon the existing state of health of the population of this country. Such expressions include the suggestion that the child born during the war years, 1914-1918, compares unfavorably with the child born in other years; a belief worthy of consideration, especially when the stringent conditions of the later years of the war are recalled, particularly the food shortage experienced in 1916-1918. The survivors of those 'war born' children are the young adults of to-day and the health of this section of the population presents a problem of particular importance. It has been said that these young adults are physically below the standard required for the future attainment of a healthy population and the high proportion of rejections among prospective Army recruits has been cited in confirmation of this opinion. In the year 1934-1935 of the 45,200 prospective recruits medically examined 14,817 or 32.78 per cent were ultimately rejected on medical or physical grounds, while in the previous year the corresponding percentage was 35.73 (1). But it is certainly true that many of these rejections were due to defects, which, while according to prevailing military standards, they excluded the examinees concerned from entering the Army, could not be taken as indicative of general ill health or of a physical condition seriously detrimental to the individual. Recruiting figures, such as quoted above must be interpreted cautiously.

Without recourse to an *ad hoc* enquiry it is impossible to trace the physical history over any length of time in this country. It is possible only to measure the war-time influences, if they exist, in the subsequent rates of mortality—and then only approximately. The belief, that the

year of birth—that is the environment into which the child is born—has some bearing upon subsequent mortality, is not new. Some few years back Kermack, McKendrick and McKinlay (2) attempted to graduate rates of mortality of England and Wales, Scotland and Sweden. They found that they could reasonably estimate rates of mortality in adult life from two factors, present age and year of birth. In the words of Greenwood (3) "A very simple expression of such an idea would be to suppose that the rate of mortality at age x was the product of two factors, one a function of age only, the other a function of the year of birth". Certainly the environment into which children were born during the war years was appreciably different from that of other years, and it might reasonably be expected, on the above hypothesis, that the subsequent mortality experience of those 'war born' children would differ from that of children born in less exacting times.

The relevant literature upon the effect of the war-years upon physique includes an investigation carried out by Wolff (4) into the physique of Berlin school children. He concluded, from his data of heights and weights, that the children born during the war years experienced only a temporary setback in their growth, the defect observed in the young ages being remedied at later ages. From Wolff's data it would appear that the war environment had no permanent effect upon the physique of children born into and surviving that environment. In the young ages (5-7) the child born during the war showed, throughout, a statistically significant adverse difference in height and weight from the children born in the post-war years. But in the older ages (13-14) the excess, which is again uniformly statistically significant, is in favour of the war over the pre-war born children with whom they are compared. Wolff concludes "There can therefore be no doubt in inferring that the growth retardation of the war birth years, still manifest at the age of school entrants, has, in the course of further growth, namely in the period entering upon puberty, been compensated, always provided that no new dangers to nutrition occur". If then it can be assumed that there is little or no difference between the post- and pre-war born children of the same age, the comparison made above appears to be valid, and as far as heights and weights are concerned the children born during the war would appear to recover the ground lost at early ages by the time that they are leaving school at 14 or 15 years of age.

In the present investigation I am limited to the study of the mortality figures available in official reports. There can be no doubt that war

conditions tend to influence the health of the population, but it may be that such influence is merely temporary as suggested by Wolff's physical data. The mortality statistics of phthisis among young adults in England and Wales point in this direction. Although the rates (Table I) for males and females aged 15-25 were, in 1934, 26 and 20 per cent

TABLE I

Showing mortality from phthisis at ages 15-25 and all ages under 65 for England and Wales

YEAR	MALES				FEMALES			
	Death rate per 100,000		Death rate as % of 1921-25 rate		Death rate per 100,000		Death rate as % of 1921-25 rate	
	15-25	0-65	15-25	0-65	15-25	0-65	15-25	0-65
1921	101	115			127	80		
1922	103	116			124	78		
1923	96 (97)	108 (112)	100	100	119 (123)	74 (76)	100	100
1924	96	109			121	74		
1925	90	110			121	72		
1926	83	101	85.6	90.2	114	66	92.7	86.8
1927	84	102	86.6	91.1	116	69	94.3	90.8
1928	83	98	85.6	87.5	113	64	91.9	84.2
1929	85	104	87.6	92.9	117	66	95.1	86.8
1930	81	95	83.5	84.8	111	63	90.2	82.9
1931	84	96	86.6	85.7	110	63	89.4	82.9
1932	80	89	82.5	79.5	107	58	87.0	76.3
1933	79	90	81.4	80.4	105	58	85.4	76.3
1934	72	83	74.2	74.1	99	53	80.3	69.7

respectively below the rates recorded in the quinquennium 1921-1925, yet the decline in the intervening years had not been uniform. As will be seen from the table the male mortality maintained a fairly constant level during the period 1926-1931 while the female rate slightly improved. It was only from 1931 that a real reduction in the death rate from phthisis in this age group 15-25 occurred. A detailed study of the trend of phthisis mortality in England and Wales by Hill (5) further

illustrates this anomalous behavior of the young adult mortality. Reviewing the history of the recent secular trend of this disease the Registrar-General (6) has said of the England and Wales experience, "It may be that the arrested fall in phthisis mortality of young adults ... was an aftermath of the effects of the food shortage of 1916-1918 upon children, resulting in a lowered average resistance to active tuberculosis of the lungs as these children reached the danger period of young adult life". The young adults who in the years 1926-1931 comprised the age group 15-25 were mainly, of course, born before the war years and since after 1931 an improvement in phthisis mortality was evident, it appears to be the children born before and passing through the war years as children, rather than those actually born in those years, who were those who suffered "the lowered average resistance" to phthisis.

The influence of war time environment on health is again suggested by Greenwood and Russell (7) in a study of mortality from nephritis. The authors have pointed out that whilst the mortality from acute and chronic nephritis had declined by 1930-1932 in the administrative areas of England and Wales in all other age groups under 45, in the age groups 15-20 amongst males and 15-25 amongst females mortality had increased in comparison with the corresponding mortalities in the triennium 1920-1922. The authors ask, "Is this a consequence of the war time environment of early life?"

Having reviewed the work of previous investigators which has a bearing upon the subject, it was thought of interest to attempt, from published statistics, to trace the subsequent mortality history of children born during the war and to compare this history with that of children born in less arduous times. To this end, the births for males and females separately, in the periods 1895-1898, 1899-1902, 1903-1906, 1907-1910, 1911-1914, 1915-1918, 1919-1922, 1923-1926, and 1927-1930, have been followed from birth through successive ages and the mortality experience for each series has been observed. The data have been taken from the Statistical Review of the Registrar-General for England and Wales over the period 1895-1935.

The scope of such an undertaking is necessarily limited and certain assumptions must unfortunately be made. Firstly no account has been taken of migration to or from the country, no figures by age being available. Secondly it has been assumed that the deaths at age 0-1 in the year x occurred amongst the births of that year and that the exposed to risk at ages 1-2 in the next year $(x + 1)$ were composed of the

survivors of the births in the year x; similarly that the exposed to risk at ages 2-3 in the year $(x + 2)$ consisted of the births of the year x less deaths aged 0-1 in the year x and aged 1-2 in the year $(x + 1)$; and so on throughout. This method can only be justified on the grounds that any adjustment must be of an arbitrary nature, particularly for children after the first year of life for whom the deaths are published in age groups of not less than one year, whereas for infants the deaths are available in weeks and months of age. The available figures give rise to a further difficulty. It was not until 1911 that deaths from all causes over the age of 5 were published by individual years of age. Prior to 1911 they were given in various age periods, even as specific causes of death are still published. This difficulty in the pre-1911 figures has been surmounted, as far as is possible, by attributing to each year of life in, let us say, a quinquennial age group, one-fifth of the deaths recorded in that five-year age period. The effects of this method have later been mitigated to some extent by calculating mortality rates over five years of age in quinquennial periods. (Also a test of the method was made by applying it to the 1907-10 group of births for which the deaths by single years were available. The arbitrary division gave closely the same results as the use of the data in single years.)

The following table illustrates the method adopted to obtain the population surviving at successive years of age from the births in any specific year for one sex.

Age in years	*Population*	*Deaths*
0-1	Births recorded in given year x	Deaths at ages 0-1 in year x
1-2	Population at ages 0-1 less deaths at ages 0-1 in year x	Deaths at ages 1-2 in year $(x + 1)$
2-3	Population at ages 1-2 less deaths at ages 1-2 in year $(x + 1)$	Deaths at ages 2-3 in year $(x + 2)$
3-4	Population at ages 2-3 less deaths at ages 2-3 in year $(x + 2)$	
	etc.	

The populations found in this way have been summed in the four-yearly periods enumerated above and used in conjunction with the corresponding deaths as a basis for the mortality rates given in Table 2.

To avoid undue disturbance of the comparison by the inclusion of the heavy abnormal mortality from the influenza epidemic of 1918 the influenzal deaths have been omitted throughout in the calculation of the death rates. For the influenza deaths, which are given in quinquennia from ages 5 to 15, the same adjustment has been made as for the pre-1911 deaths from all causes. Since the latest official mortality statistics available when this analysis was made related to the year 1935,

TABLE 2

Showing the death rates by ages of children born in various periods in England and Wales

(*Death rate per 10,000 from all causes less influenza*)

AGE	YEAR OF BIRTH								
	1895-98	1899-1902	1903-06	1907-10	1911-14	1915-18	1919-22	1923-26	1927-30
					Males				
0-	1700	1638	1469	1246	1208	1091	909	808	751
1-	500	442	403	357	345	298	214	210	177
2-	190	166	150	138	139	136	87	82	73
3-	118	102	92	81	85	80	53	51	43
4-	88	71	64	60	66	51	38	38	35
5-	36	33	29	34	33	25	24	23	...
10-	19	19	21	18	16	16	14	...	...
15-19	31	34	26	24	24	23	...	...	...
					Females				
0-	1405	1350	1207	1005	973	859	702	623	575
1-	470	409	379	333	316	277	197	187	158
2-	183	162	143	133	129	131	83	75	69
3-	119	104	92	79	83	81	51	47	40
4-	88	71	66	60	66	51	35	35	33
5-	37	34	29	34	32	24	22	21	...
10-	21	20	22	19	15	15	13	...	...
15-19	27	30	25	24	23	21	...	...	...

it follows that the births of the later periods, 1919-22, etc., cannot be followed to so old an age as those of the earlier periods which have been observed to age 19.

Before any comment upon the table is made it may be convenient to restate the problem. If the 'war born' child shows any ill effects due to such unfavourable conditions as food shortage there should be some indication of this in the subsequent mortality of the 1915-1918 births. It would be expected that such an indication would take the form of a somewhat more severe mortality experience for these children as compared with their predecessors or their successors, always taking into account the effects of the secular trend of the death rate.

The results set out in Table 2 do not appear to bear out the hypothesis that the children born during 1915-1918 are those who suffer from the effects of the war in their immediate after life. Rather it would appear to be those born before the war and passing through it as children and young adults who bear the burden of the hardship and experience a comparatively high mortality actually at the time when passing through these war years. This is not evident in the first two age groups 0-1 and 1-2 but the remaining age groups present an interesting picture. To facilitate the interpretation of the results Table 3 has been prepared to show the rates of the previous table expressed for each age and sex as a percentage of the 1895-1898 rates.

It will be seen that the general trend of the death rates in each age group through successive series of births takes the form of a general decline from the 1895-1898 to the 1927-1930 series but with a definite discrepancy in all groups of 2 and over. This discrepancy takes the form of a rate in one series exceeding the corresponding rate in the immediately preceding series. Thus at age 3-4 the rates for males are 118, 102, 92, 81, 85, 80, 53, 51 and 43 deaths per 10,000, taking the series chronologically. The discrepancy is the rate of 85 which in this case occurs for the children born in 1911-1914. The tendency throughout is for this abnormally high rate to occur during the war years themselves. Thus it is observed for males born in 1911-1914 at ages 2-3, 3-4 and 4-5, as will be seen from Table 3, the rates at these ages are respectively 73.2, 72.0, and 75.0 per cent of those of the 1895-1898 series, compared with 72.6, 68.6 and 68.2 per cent for the preceding series, 1907-1910. For females the abnormalities occur at ages 3-4 and 4-5 in the same series of births as for males, that is 1911-1914, but at age 2-3 the discrepancy arises in the 1915-1918 series. Similarly in the

TABLE 3

Showing death rates by ages of children born in various periods in England and Wales as percentage of the death rates of children born in the period 1895-98

AGE	YEAR OF BIRTH								
	1895-98	1899-1902	1903-06	1907-10	1911-14	1915-18	1919-22	1923-26	1927-30
					Males				
0-	100	96.4	86.4	73.3	71.1	64.2	53.5	47.5	44.2
1-	100	88.4	80.6	71.4	69.0	59.6	42.8	42.0	35.4
2-	100	87.4	78.9	72.6	73.2	71.6	45.8	43.2	38.4
3-	100	86.4	78.0	68.6	72.0	67.8	44.9	43.2	36.4
4-	100	80.7	72.7	68.2	75.0	58.0	43.2	43.2	39.8
5-	100	91.7	80.6	94.4	91.7	69.4	66.7	63.9	...
10-	100	100.0	110.5	94.7	84.2	84.2	73.7	...	...
15-19	100	109.7	83.9	77.4	77.4	74.2	...	...	...
					Females				
0-	100	96.1	85.9	71.5	69.3	61.1	49.9	44.3	40.9
1-	100	87.0	80.6	70.9	67.2	58.9	41.9	39.8	33.6
2-	100	88.5	78.1	72.7	70.5	71.6	45.4	41.0	37.7
3-	100	87.4	77.3	66.4	69.7	68.1	42.9	39.5	33.6
4-	100	80.7	75.0	68.2	75.0	58.0	39.8	39.8	37.5
5-	100	91.9	78.4	91.9	86.5	64.9	59.5	56.8	...
10-	100	95.2	104.8	90.5	71.4	71.4	61.9	...	...
15-19	100	111.1	92.6	88.9	85.2	77.8	...	...	...

age group 5-6 both sexes show increased mortality in the 1907-1910 series compared with that of 1903-1906 while the excesses are noted in the 10-14 and 15-19 groups in the 1903-1906 and 1899-1902 series respectively. There is clearly little difference between the results exhibited by the two sexes.

Now it is obvious that most of the deaths contributing to these abnormally high rates at the different ages must have occurred during

the war years themselves, 1915-1918. Unfortunately the presentation of the rates in quinquennial age groups in the later ages makes it impossible to isolate the war mortality completely: the tendency alone can be shown. In this respect it is significant that the neighboring rates to those we have termed 'abnormally high' do themselves appear to be fairly high in a number of instances. Thus in the 5-6 age group of females the percentage (of the corresponding rate in the 1895-1898 series) of 91.9 in the 1907-1910 series is the abnormally high figure compared with 78.4 observed in the preceding series 1903-1906; but we must also note the fairly high figure of 86.5 in the 1911-1914 series. On examination it will be seen that such fairly high rates also include a considerable proportion of war time deaths. It may also be noted that immediately after the high or fairly high peak of the war years there is a sharp fall to a low level in the following series. Thus in the age group 10-14 for males the rate falls from 110.5 per cent in the series of 1903-1906 to 94.7 in the following series. In some age groups the heavy fall does not immediately follow the peak, but it must be remembered that the intervening series is still exhibiting war mortality at those ages.

From this analysis it appears that the children born under the war conditions have not experienced any adverse effects in their subsequent mortality history, that is up to age 19. On the other hand, the children born before the war and exposed through it appear to have suffered from its hardships as is indicated by the heavy mortality shown in each series at ages attained during the years 1915-1918. The effects upon health as judged by mortality have been immediate and not continued. It may, of course, be that the method used is too approximate to illustrate the history of the war births fully, it may be suitable only for the indication of the more positive tendency of the high war mortality. It goes without saying that mortality may be an inadequate index for the purpose, it is not difficult to envisage a population suffering from the effects of malnutrition and kindred hardships without being "sick unto death".

SUMMARY

An attempt is made to see whether children born in England and Wales during the war years give any indication, in their mortality in later life, of the effects of the environment into which they were born. No such effect is found in subsequent years up to age 19. On the other

hand mortality up to that age of those born in pre-war years was uniformly increased during the years 1915-1918. The war effect on mortality was immediate but not continued.

REFERENCES

1. Report on the Health of the Army for the Year 1935. Vol. 71, p. 48.
2. KERMACK, W. O., MCKENDRICK, A. G., and MCKINLAY, P. L. 1934. Death rates in Great Britain and Sweden. Expression of specific mortality rates as products of two factors and some consequences thereof. *Jour. Hygiene*, 34, p. 433.
3. GREENWOOD, M. 1936. English death-rates, past, present and future. *Jour. Roy. Stat. Soc.*, 99, Pt. IV, p. 674.
4. WOLFF, G. 1935. Increased bodily growth of school children since the war. *The Lancet*, Apr. 27th, p. 1006.
5. ANNUAL STATISTICAL REVIEW OF THE REGISTRAR-GENERAL for England and Wales. Text. 1934. p. 71.
6. HILL A. BRADFORD. 1936. The recent trend in England and Wales of mortality from phthisis at young adult ages. *Jour. Roy Stat. Soc.*, 94, Part II, p. 247.
7. GREENWOOD M., and RUSSELL, W. T. 1938. Brights disease, nephritis, and arterio-sclerosis: A contribution to the history of medical statistics. *Biometrika*, 29, p. 249.

IS THE HUMAN GROWTH TIDE TURNING?

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A FEW months ago one of us (1) pointed out the trend toward earlier menarchial age that has been in evidence in most countries of the earth for many decades. Accompanying this trend toward earlier sexual development, there has occurred also quickening of growth through childhood and youth and the attainment of ever increasing adult stature (1,2). In several regions the menses now begin 2 years earlier than they did a century ago, and 1 year earlier than was the case back only 3 decades. The average height of English soldiers has increased about 4 inches in the past century and that of American college men about 2 inches in the last half century.

These quickenings in growth and in sexual development are also closely related in ways other than in their mere time association back through the decades. In man and animals the onset of the sexual cycles, and later of fertility, seems determined largely by physical development as represented by body size and weight (3, 4). Sexual maturity is thus not so much a matter of chronologic age as of physical age and nearness to adult size. In both human and animal findings, retardation of growth is accompanied by later onset of sexual activity, and growth stimulation by onset of sex functions at an earlier age.

The past century's quickened physical and sexual development of the human race was accompanied by a marked increase in fertility, an increase that roughly doubled the earth's population during the 19th century. Towards the close of the century, however, this wave of population increase seemed definitely to have passed its peak. In more recent decades the decline in reproduction has become so precipitous as to provide one of the major worries of scientists in the political and social fields. Have we passed a crest in world population numbers? And are we now headed for racial stabilization, or for a far-reaching recession? The answers to these vital questions cannot be had from population and reproduction statistics alone, but must also be based upon

a consideration of the factors of biologic response that determine reproductive potentials. What are these factors of biologic response that may point the way for human trends on earth?

Foremost among them in all warm-blooded species is the domination exercised over body metabolism and combustive processes by the ease or difficulty of body heat loss. All body processes are basically combustive in nature and are linked with the production of excess heat which must be dissipated from the body. The body is highly efficient as an energy-conversion machine, but it is not 100 per cent efficient. Therefore it is faced with the problem of heat dissipation just in proportion to the intensity of its internal combustive processes. But in the higher warm-blooded forms efficient body functioning is also dependent upon the maintainance of an internal body temperature within a very narrow range, with serious and quickly fatal consequences following divergence from this range. It therefore becomes necessary, as heat loss from the body is made more and more difficult by outside warmth, that the body's internal combustive activity and heat production be lessened. This is exactly what takes place as the body responds through the weeks or years to non-fatal outside warmth.

Most affected by this slowing in combustive processes, as body heat loss grows more difficult, are the direct energy phases of existence (energy of thought and action) and the secondary energy phases that involve growth, fertility and resistance to infection. It has been clearly shown, directly on experimental animals under controlled conditions and by human statistics, that growth and sexual functions are quickly and strikingly responsive to external temperature levels and the ease of body heat dissipation (1,5,6). Complete sterility and cessation of growth can be produced within a few days by difficulty of heat loss that is not fatal nor particularly disturbing otherwise to the body mechanism. But if such a metabolic suppression is continued for several months, then recovery of active function is slow. Reproductive statistics on whole population groups show this response just as clearly as do studies on white mice.

Nutritionists and dietary experts have held the improvement in human growth and development to be largely a result of mass betterment in dietary and hygienic standards, and they are probably correct to a considerable degree. But behind such improvement lies also this other basic factor of ease of body heat loss which can not be overcome or counterbalanced through dietary channels. The direct response of

experimental animals, and of people to regional and seasonal variations, leads to the suspicion that the longer-term changes in human growth and reproductivity may also be due to this basic temperature factor.

Temperature records back through the past two centuries show subnormal levels generally over the earth during the first half of the 19th century, then a slow and irregular rise on up to 1920, but a marked accentuation of the up-trend since that time. With the cold of the 19th century came the doubling in earth population numbers and the quickening in growth and development. In recent decades, however, the reproductive rate has been sharply declining in many countries, turning abruptly downward in this country after 1921. If there really is a causal relationship between external temperature levels and such human functions as fertility, growth rate and sexual development, then children born since 1920 should show the effects of lessened stimulation from the recent higher temperature levels. It is the finding of early signs of such change in trend that prompts the preparation of this article. The final paragraph of an earlier paper (1) may well be quoted here:

> We have shown in previous papers how a rise of mean temperature level produces a prompt diminution in fertility in either man or animals, and how reproductive functions respond to optimal coolness. Is it not possible that world population growth may be governed by these same biologic principles? Observations over a few more years will provide the answer, for girls born since 1920 are now entering puberty and, if the effects of rising world temperatures are as discussed in these pages, we should soon see a reversal in trend of puberty onset toward later instead of earlier ages.

During the past few months we have calculated the mean menarchial age of college girls, grouped by their year of birth. Statistics on this point were obtained from student health records of the Universities of Cincinnati, Wisconsin and Southern California, and are summarized in the accompanying tables.

In Table 1 is confirmed the previously described trend toward ever earlier menarche that was in evidence with those girls born before 1920. In two decades the menarchial age has dropped almost a year. The change in trend evidenced by the relatively small group of the 1937 entering class that was born in 1920 is all the more significant in view of the fact that with all previous entering classes the youngest members have regularly shown the earliest menarchial age (see Table 2).

Another finding brought out in Table 2 is that, up to 1935, girls of any birth year showed an earlier menarchial age the later they entered the University. In the last three entering classes (1935, 1936, 1937)

TABLE 1

Menarchial age by year of birth
(Univ. of Cincinnati girls)

YEAR OF BIRTH	NO. OF CASES	MEAN MENARCHIAL AGE IN YEARS
1888-1904 (incl.)	28	14.0357±0.1850
1888-1909 (incl.)	111	13.7793±0.0843
1909	44	13.6816±0.1459
1910	93	13.6935±0.0854
1911	178	13.6966±0.0625
1912	177	13.5677±0.0589
1913	251	13.5398±0.0486
1914	286	13.3881±0.0466
1915	300	13.3766±0.0445
1916	280	13.3285±0.0447
1917	292	13.2938±0.0454
1918	328	13.1981±0.0454
1919	220	13.0863±0.0523
1920	56	13.1607±0.0997

this has been reversed, menarche having come at progressively later ages as university entrance was delayed. It would therefore seem that the entering class of 1935 represents in general the earliest menarche, and that a real change in trend has taken place.

TABLE 2

Menarchial age by year of birth and year of university enrollment
(Univ. of Cincinnati girls.)

YEAR OF BIRTH	ENTERING CLASS OF 1933	1934	1935	1936	1937
1913	13.42 (13)*	.....	.....	.....	.....
1914	13.45 (43)	13.43 (14)	.....	.....	.....
1915	13.46 (165)	13.41 (46)	13.29 (14)	.....	.....
1916	13.20 (50)	13.37 (150)	13.20 (50)	13.75 (16)	.....
1917	13.00 (6)	12.99 (43)	13.16 (155)	13.56 (51)	14.26 (17)
1918	.....	13.00 (4)	12.84 (47)	13.26 (237)	13.42 (48)
1919	.....	.....	12.50 (4)	12.93 (42)	13.15 (178)
1920	.....	.....	.....	13.00 (2)	13.17 (54)

* Numbers in parentheses indicate number of cases.

Girls entering the University of Southern California show the same general time changes in menarchial age as do those at the University of Cincinnati (see Table 3). Here again it is the youngest group of the

TABLE 3

Menarchial age by year of birth
(Univ. of Southern California girls.)

YEAR OF BIRTH	NO. OF CASES	MEAN MENARCHIAL AGE IN YEARS
1881-1900	89	13.6910±0.0876
1901-1911	301	13.6827±0.0510
1912	107	13.5561±0.0926
1913	148	13.5811±0.0689
1914	261	13.5651±0.0532
1915	344	13.4913±0.0454
1916	426	13.4624±0.0414
1917	456	13.3026±0.0377
1918	436	13.3280±0.0416
1919	348	13.1782±0.0434
1920	118	13.2119±0.0719

1937 entering class that shows the change in trend toward later menarchial age, in direct contrast to the findings with the entering classes of previous years (Table 4).

TABLE 4

Menarchial age by year of birth and year of university enrollment
(Univ. of Southern California girls.)

YEAR OF BIRTH	ENTERING CLASS OF		
	1934	1936	1937
1914	13.78 (84)	.....	.....
1915	13.60 (107)	.....	.....
1916	13.25 (105)	13.62 (141)	.....
1917	13.17 (43)	13.28 (200)	13.43 (138)
1918	.....	13.30 (190)	13.34 (210)
1919	.....	13.09 (108)	13.19 (227)
1920	.....	.....	13.30 (103)

In more northerly latitudes, at the University of Wisconsin, the change in trend has not yet appeared with the girls born in 1920 or 1921 (Table 5). The tendency there is still an ever earlier onset of the menses. It would seem highly desirable that this point be checked with a considerable number of college and university student groups in order to arrive at a more exact picture of the change taking place.

TABLE 5

Menarchial age by year of birth
(Univ. of Wisconsin girls.)

YEAR OF BIRTH	NO. OF CASES	MEAN MENARCHIAL AGE*
Before 1900	17	14.0294±0.2332
1900-1910	96	13.7604±0.1103
1911-1912	58	13.4138±0.1277
1913	69	13.4275±0.0845
1914	99	13.3485±0.0847
1915	123	13.3780±0.0738
1916	141	13.4220±0.0900
1917	270	13.4148±0.0510
1918	213	13.1150±0.0515
1919	177	13.1893±0.0610
1920	88	13.0114±0.0818
1921	9	12.3889±0.2234

*Inclusion of a much larger number of cases in each age group would no doubt reduce irregularities in the menarchial age trend observed here.

In experimental animals we have been entirely unable by dietary adjustment to overcome the growth-depressing effect of difficulty in body heat loss. Our animal findings have all been obtained with fully adequate diets supplied in unlimited amounts to the hot and cold room animals alike. Increase in protein content of the diet, instead of overcoming the heat depression of body growth, was poorly tolerated by the hot-room animals and actually added to the growth retardation. Human beings in tropical heat also find themselves unable to handle a diet with protein content as high as seems desirable in temperate zone coolness. The specific dynamic effect of ingested protein might well be expected to produce this very effect under conditions of external warmth that render body heat loss difficult. In polar cold, on the other hand, this

same protein stimulation of heat production is most welcome, and we see polar natives living on a dietary remarkably high in protein.

It is impossible to assay the part dietary improvement has played in the increased human growth and developmental rate, and in adult size. If, however, growth and development should now reverse their trend of the past many decades, as the effects of rising world temperatures become more pronounced, then we will have reasonable grounds for placing real emphasis on the climatic temperature factor. There will then also arise a strong suspicion that this same rising world temperature may be an effective factor in the reduction in human reproduction that is showing forth in so many of the most energetic population masses of today.

One of us (2) recently pointed out the steady increase in height and weight of men entering the University of Cincinnati. The entering women, however, have shown no significant upward trend in height since 1926, nor in weight since 1920. This growth trend difference between the two sexes is probably related to the advance in menarchial age toward even earlier years and the cessation in growth that takes place in girls within about two years after the menses begin. Boys, on the other hand, grow in height and weight throughout the puberty period. It is somewhat difficult to anticipate just what growth changes may result in the girls as the menarche now turns toward later ages.

Perhaps we should look more to male stature for the indications of effects of rising world temperatures. University of Cincinnati men of the 1937 entering class are lighter in weight than has been the case since the 1930 entering class, and are shorter than any class since that entering in 1934 (the average age remaining practically unchanged). Actual figures on these men are:

477 entering 1936-7,	av. age 18.82 yrs.,	ht. 69.36 in.,	wt. 145.10 lbs.
538 entering 1937-8,	av. age 18.87 yrs.,	ht. 69.20 in.,	wt. 141.01 lbs.

Great interest will attach to height-weight and menarche records on the entering university classes of future years. Deductions to be drawn from the changes in developmental trend here forecast have a direct bearing on the problems of racial existence, for the findings of the next few years will determine whether human growth and reproduction are really dominated by temperature levels and ease of body heat loss to the same degree as has been shown for laboratory animals under controlled conditions. Particularly interesting will be the developmental data on children born during the world-wide warmth of 1930-35.

CONCLUSION

A definite answer to the question "Is the human growth tide turning"? must await the passage of a few more years of careful observation. Present indications are, however, that a growth and developmental peak has been reached and passed, and that future decades are likely to witness a considerable expansion of the racial recession.

For several generations children have quite generally exceeded their parents (of like sex) in stature and earliness of puberty onset. This phenomenon seems likely to occur with decreasing frequency in the future. Berth length in American sleeping cars has been repeatedly lengthened, from 71 inches (center to center of partitions) in 1859 to a 77½-inch actual mattress length in many berths of the new cars now being put into commission. It seems fallacious, however, to consider a projection of this growth trend into an indefinite future. It is more likely based on extrinsic forces, over the effects of which man really can exert little influence.

REFERENCES

(1) MILLS, C. A. Geographic and time variations in body growth and age at menarche. HUMAN BIOLOGY, 1937, 9, 43-56.

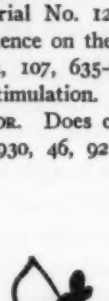
(2) CHENOWETH, L. B. Increase in height and weight, and decrease in age of college freshmen. *J.A.M.A.*, 1937, 108, 354-356.

(3) HARTMAN, CARL G. On the relative sterility of the adolescent organism. *Science*, 1937, 74, 226-7.

(4) SHUTTLEWORTH, FRANK, K. Sexual maturation and the physical growth of girls age 6 to 19. *Monographs of the Soc. for Research in Child Development*, Vol. II, No. 5, (Serial No. 12) *Washington, D. C.*, 1937.

(5) OGLE, CORDELIA. Climatic influence on the growth of the male albino mouse. *Amer. Jour. Physiol.*, 1934, 107, 635-640. Also: Adaptation of sexual activity to environmental stimulation. *ibid.*, p. 628-634.

(6) MILLS, C. A., and F. A. SENIOR. Does climate affect the human conception rate? *Arch. Int. Med.*, 1930, 46, 921-9.



ON HUMAN SOCIAL BIOLOGY
II. DISRUPTIVE AND COHESIVE FACTORS IN THE MARITAL GROUP[1]

BY ANTONIO CIOCCO

INTRODUCTION

IN THE first paper of this series (Ciocco, 1938), several questions regarding the method of approach to the study of human social biology were discussed. It was pointed out that the social activities of man reflect to a greater or less degree, at one and at the same time, his powers of rationalization and his fundamental biological constitution. This is to say, in effect, that man has certain attributes and behavior characteristics in common with other animals and in addition possesses the ability to formulate and express abstractions. He not only responds to internal physiological stimuli and to the external physico-chemical ones, but he also thinks and talks about them and in consequence initiates a whole train of factors which in the end determine the mores, laws, and social institutions. These social manifestations may be regarded as the limits of the permissible range of variation of individual activity in the relations between individuals. These limits are a product of the individuals themselves and therefore depend on the variable physical, physiological and psychological characteristics of man. From this premise it results that the study of any social phenomenon resolves itself in final analysis to the investigation of a particular type of individual interactions which in turn depend upon the kind of individuals composing the group. To illustrate and amplify this viewpoint is one of the purposes of this paper which presents data on certain factors that affect the relations between members of one particular type of social group: the marital couple.

It is possible to define any human social group as being an association of persons who temporarily or permanently possess one or more attri-

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butes, functions, or characteristics in common no matter how much they may differ otherwise. The most important of the social aggregates to which an individual may belong is the marital group because in our civilization it is mainly responsible for the reproduction of the species. Marriage or the general relationship between the individuals forming the marital group "may be defined," says Westermarck, "as a relation of one or more men to one or more women that is recognized by custom or law and involves certain rights and duties both in the case of the parties entering the union and in the case of children born of it." As a social institution it is found in some form or other among all peoples and well illustrates the differences already discussed between man and other animals. The mating behavior of other animals with its characteristics of sexual attraction and intercourse, nidification, and reproduction has been modified in man by the complex sets of limits imposed on his behavior through his own conscious efforts. The final result has been that many more factors other than, and often to the apparent exclusion of, the elements of mating enter into marriage. This is one of the reasons why the attempt to trace the origin of the institution of marriage from mating habits of lower animals has proven noticeably unsuccessful. This approach which has received its fundamental impulse from Darwin's enunciation of the theory of organic evolution, has been adopted by both Westermarck and Briffault. The former, in his now classical work, interprets animal observations to indicate that the roots of the monogomous patriarchal type of marriage have a deep biological foundation common to certain animals and primitive man. Briffault instead believes the evidence shows that the primitive marital pattern was limited to a temporary coital contact and that marriage, as we know it, results from the transformation of a matriarchal type of family. The disagreement between the theories of these two eminent students of the subject arises from their interpretation of data on primitive people as well as on lower animals. This disagreement also demonstrates the sources of errors involved in the methodology which proceeds from the unknown past to the present. When the origin of a human trait is sought in animals or in very primitive peoples it is assumed that in them is present the original trait from which that of man has evolved. But this assumption cannot be always accepted inasmuch as the direction and processes of evolution are for the most part still a mystery. Here it might be added that neither Westermarck nor Briffault present con-

vincing evidence to show how the modern family and rules of marriage actually came about.

When the origin of present customs are sought in the laws and customs of past or of primitive peoples too much reliance is often placed on the value of the sanctions. This is to be noted in general in the historical work of Sir Henry Maine and is also apparent in the recent study of the history of marriage by Goodsell. Actually a law does not represent a rule of conduct as much as a desired rule and its efficiency is dependent upon the favor with which it is met by the group to which it is applied. The 18th amendment to the U. S. Constitution and the public reaction to it are well worth remembering. If the student of social behavior of the year 3000 follows the usual inferential methods, he might conclude that the law served to remedy a bad situation, or else that the law expressed the customs of the people. On both scores he would be wrong.

When attempting to evaluate the laws and mores of the past it is too often overlooked that living is a dynamic process, a continuous adaptation to changing conditions and that the laws and mores are simply a reflection of this process and represent in general only the rationalization of man's activity. Therefore to arrive at an understanding of the basic elements of man's behavior characteristics it is to man himself that we must turn, to what he does and says he does and not simply to his more or less rational explanation. The past records of modern man, those of primitive peoples, observations and experimentations on lower animals, all will serve to elucidate the behavior of man of today only after some more precise knowledge is obtained on how the man of today behaves. It appears that this point of view is more or less shared by a number of students of social sciences. In particular, in the last two decades studies on the marital couple and on the sex behavior of man have flourished furnishing some valuable material. One need only recall the works of Hamilton, Davis, Dickinson and Beam, and Bromley and Britten. With particular relation to the interaction within the marital group the studies of Mowrer and Lumpkin deserve to be mentioned. To the end of contributing towards the knowledge of the basic facts regarding the interaction of the individuals involved in the marital group an analysis has been made of the problems of almost 400 married women, the main purpose being to inquire into the factors involved in the breakdown and conversely in the persistence of the marital union.

Material

The material of this study consists of the letters of 390 married women who requested aid and advice regarding their marital problems from a well-known popular advisor[2] of the public on these and other personal problems. Through the kind cooperation of this person all the letters on the subject of sex and marital problems received during a three-month period, January-March 1938, were turned over to the present writer. In total these letters number over 1500. Of them, 390 were written by married women and related to problems of intra-marital relations. The letters relating to the same problems written by men were too few in number to permit separate analysis and therefore are not discussed here, since it does not seem justifiable to include them with the letters from the women.

From the nature of the sample it follows that the women concerned are literate, have a marital problem and are unable to solve it. These characteristics impose certain limitations with regard to the direction of the analysis and also on the conclusions which may be drawn from it. In addition, generalizations cannot be carried too far because the husband's side of the question is not known, and adequate information cannot be obtained about the complete personality of either the wife or the husband.

Notwithstanding these limitations, the information that can be acquired from such material seems, for certain reasons, especially useful as a means of understanding the fundamental characteristics of marital interactions. These letters express the ideas and feelings, ***given under no outside compulsion, suggestion, or stimulation,*** of women faced by relatively difficult situations in marital relationship and who are about to reach decisions with reference to them. As is usual when advice is sought, what is really wanted is acquiescence to one's own views. These women illustrate the universality of this recognized psychological phenomenon. All of them in these letters present a tentative solution to their problem and the reason or justification for it. It is thus possible to obtain an unusual degree of insight relative to the actual mechanism by which certain aspects of marital interactions originate, since these are the spontaneous revelations of the participants themselves. These revelations indicate both the extent to which the mores and laws re-

[2] Who for obvious reasons prefers anonymity.

garding marriage act as limitations, and also how they operate in helping to create the mores and laws of the future.

Elements of conflict

The chief complaints advanced by these women have been grouped together according to the classification presented in Table 1.

TABLE 1

The stated elements of the marital conflicts experienced by 390 women

ELEMENTS OF CONFLICT	WOMEN	
	Number	*Percent*
Relative to specific intra-marital relations:		
Masculine domination	80	20.5
Affective maladjustment	72	18.5
Non-support	28	7.2
Sexual-reproductive disharmony	21	5.4
Relative to husband's extra-marital behavior:		
Infidelity	123	31.5
In-laws	36	9.2
Social vices	30	7.7
All elements together	390	100.0

The first four categories refer to difficulties which arise from the specific interaction between husband and wife and involve other people in a very minor degree if at all. Among these four classes, the most frequent group of complaints concerns masculine domination. Under this heading are included the conflicts which derive from the wife's reaction to the husband's tendency to dominate in matters of her conduct regarding the household, expenditures, the discipline of children, and personal habits and relations. Charges of cruelty, jealousy, or stinginess made against the husband are found here. Next in order of importance as an element of conflict appears the class of affective maladjustment which involves lack of correspondence regarding the manifestations of the so-called tender emotions. Laziness and the general inability to satisfy the desired economic needs are elements included in the non-support category. Sexual-reproductive disharmony

concerns those complaints of either excessive or insufficient sexual intercourse or disagreement regarding the question of having offspring.

The next three classes refer to conflicts engendered by the husband's relations to other persons. The most important of these and of the sample as a whole is infidelity. Next in order is the class of conflicts deriving from interference by the husband's kinsfolk. Complaints about habits of drinking, gambling and carousing in general are included in the social vices category.

From Table 1, it is seen that infidelity on the part of the husband, his tendency to dominate, and the lack of correspondence in affective manifestations are the stated elements of about 70 percent of the difficulties encountered. Conflicts attributed directly to the sexual and reproductive aspects of marriage are the least important. The significance of the relative frequency with which these elements occur in the marital conflicts and the importance of these elements as factors in the disruption of the marital group will be discussed later. Here it is sufficient to note that the prominent position occupied by infidelity as a factor in the wife's marital unhappiness is not surprising. Adultery on the part of the husband is and has been so widespread that a majority of laws and taboos conveniently overlook it. In Hamilton's sample of married men, 28 percent had committed adultery; this figure was constituted by 40.8 percent of men whose marriages were unsatisfactory and only 15.7 percent of those happily married.

In general, however, adequate data for comparative purposes are not available. The laws of this and other countries permit divorce only for certain specified reasons. As a result, data on the causes of divorce reflect essentially the requirements of the laws and give no inkling of the underlying factors. Mowrer's investigation of a selected group of families revealed that abuse, drinking, and immorality on the part of one or the other partner were the predominating factors in family discord. Mowrer's observations are, however, presented in a form which does not permit comparison with those reported here.

Age and duration of marriage in relation to the elements of conflict

Among these women, 193 stated their ages in years and of them 13.5 percent are below 20 years of age, 46.1 percent are between 20 and 29 years, 19.7 percent are in the fourth decade, and 20.7 percent are 40 years or older. According to the age characteristic then, this group is not representative of the general population of married women since

TABLE 2

Age and elements of marital conflict

ELEMENTS OF CONFLICT	AGE OF WOMEN (*in years*)								TOTAL WOMEN	MEAN AGE (*in years*)
	Under 20		20-29		30-39		40 and over			
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*	*No.*	*Percent*		
Affective maladjustment	11	42.3	20	22.5	9	23.7	4	10.0	44	27.6
Masculine domination	7	26.9	12	13.5	6	15.8	9	22.5	34	31.9
Non-support	4	15.4	9	10.1	3	7.9	1	2.5	17	26.6
Social vices	2	7.7	5	5.6	5	13.2	3	7.5	15	32.4
Sex.-repro. disharmony	1	3.8	10	11.2	2	5.3	1	2.5	14	27.7
Infidelity	1	3.8	25	28.1	10	26.3	22	55.0	58	35.2
In-laws	..	...	8	9.0	3	7.9	..	...	11	27.7
All elements	26	99.9	89	100.0	38	100.1	40	100.0	193	31.2±.5

the census of 1930 reports the following percentages in the respective age groups and in the order given above: 2.8, 25.1, 28.5 and 43.7. The women of this sample are therefore younger than the average of the married female population of this country. This may mean that older women are less apt to complain, have fewer problems, or else are better able to solve what problems they have. It is probable that all three factors are involved.

The relative frequency of the elements of conflict according to the age group in which the women belong is shown in Table 2.

From this table the following facts appear important.

1. Conflicts due to affective maladjustment are reported by 42.3 percent of the women below 20 years of age but by only 10.0 percent of the women 40 years and older. The difference between these two percentages is probably significant statistically.

2. Conversely, only 3.8 percent of the youngest women complain of their husband's unfaithfulness while this complaint is made by 55.0 percent of the oldest women. Notwithstanding the small numbers involved the difference is apparently not due to chance.

3. As is to be expected from the above, the women whose marital difficulties are said to be due to affective maladjustment are definitely younger on the average than those who complain of infidelity by the husband.

TABLE 3

Marriage duration and elements of marital conflict

ELEMENTS OF CONFLICT	MARRIAGE DURATION (*in years*)						TOTAL WOMEN	MEAN MARRIAGE DURATION (*in years*)
	Under 5		5-14		15 and over			
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*		
Affective maladjustment	35	28.5	13	16.7	9	11.5	57	6.7
Masculine domination	26	21.1	15	19.2	14	17.9	55	8.8
Infidelity	21	17.1	30	38.5	38	48.7	89	12.4
Non-support	12	9.8	7	9.0	3	3.8	22	7.0
Social vices	10	8.1	4	5.1	9	11.5	23	10.4
Sex.-repro. disharmony	10	8.1	3	3.8	3	3.8	16	6.9
In-laws	9	7.3	6	7.7	2	2.6	17	6.9
All elements	123	100.0	78	100.0	78	99.8	279	9.3±.3

Due to the close association between age and the duration of marriage it is also found that the relative frequency of affective maladjustment is much higher among the women married less than five years than among those married 15 years or more. For infidelity, this relation is reversed.

From Table 3 it is seen that 28.5 percent of the women married less than 5 years complain of affective maladjustment but only 11.5 percent of the women married more than 15 years make the same complaint. With regard to infidelity this enters into the difficulties of only 17.1 percent of the former and 48.7 percent of the latter class of women. For both elements, the differences are statistically significant. The size of the sample is small and therefore no attempt can be made to separate the age factor from that of the duration of marriage, so it will be assumed that both coexist.

If the age (and duration of marriage) trend for the frequency of affective maladjustment is considered as being independent of that for infidelity, the following inferences may be drawn from the above findings:

1. With increasing age and experience the romanticism and sentimentality of youth diminishes, therefore the individuals acquire a more realistic and sober outlook on marriage and greater tolerance and understanding of the peculiarities of the husband's affective behavior. Consequently more importance is attached to those aspects of the husband's behavior which might affect the stability of the home.

2. In addition it may also be that marriages in which affective maladjustment occurs early do not survive. Instead, due to the "double standard", adultery on the part of the husband is accepted, though painful.

3. The effect of age on the physical attractions of the wife combined with the desire for variety turns the husband more often, as time passes, towards other and fresher fields.

On the other hand, it could alternatively be argued that there is a causal relation between the phenomenon of affective maladjustment and that of infidelity. These data would then suggest that the relative lack of tender emotions on the part of the husband is a first sign of an attitude which will eventually terminate in infidelity. The sequence of events would then be: diminished sentimental manifestation, decreased desire for the spouse and increased desire for another woman; the origin of the sequence would exist in the early part of marriage.

Whether either of these hypotheses is valid cannot be known without further and more detailed information.

Elements of conflict in relation to independent means and other love interests

Among this sample of women, 104 state that they are not dependent upon the husband for the means of making a living. The majority of them work but some have families able to care for them while a few have an independent income. In addition, 13 of these 104 women have other male love interests. There are 35 other women who also have other men at their disposal, making a total of 48 who are finding it difficult to remain constant to their matrimonial choice. The pattern of the distribution of the elements of conflict in the two groups of women compared to that for all the women is shown in Table 4.

TABLE 4

Elements of marital conflict in women with independent means and with other love interests

ELEMENTS OF CONFLICT	ALL WOMEN		WOMEN WITH INDEP. MEANS		WOMEN WITH OTHER LOVE INTERESTS	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*
Infidelity	123	31.5	22	21.2	9	25.7
Masculine domination	80	20.5	24	23.1	6	17.1
Affective maladjustment	72	18.5	11	10.6	12	34.2
In-laws	36	9.2	6	5.8	..	...
Social vices	30	7.7	12	11.5	2	5.7
Non-support	28	7.2	23	22.1	3	8.6
Sex.-Repro. disharmony	21	5.4	6	5.8	3	8.6
All elements	390	100.0	104	100.1	35	99.9

It is seen that the women with independent means differ in a striking fashion from all the women because the former complain of non-support three times more frequently than all the women of the sample. Women with independent means comprise 83 percent of the women who com-

plain of non-support. The women with other love interests also differ from the whole sample, in that they complain about affective maladjustment almost two times more often than all the women together. Notwithstanding the small numbers involved these differences are probably not due to chance.

These observations point to the subjective nature of the complaints and consequently to the importance of studying the total personality of the individuals of the group. When the woman complains of affective maladjustment it may be that her affective needs are greater or less than the husband can give. In addition, deviation of affection towards another man may be the cause as well as the effect of this sentimental disharmony and this cannot be learned unless the individual traits of the partners are known. It will also be noted that the majority of the women who complain of non-support have independent means, a good number having an extra-domestic occupation which they have to conserve while married. Therefore the complaint of non-support does not arise from actual want but rather from the outraged feelings of these women who are forced to carry on the rôle of supporter.

Reactions to the conflicts

The means by which these women propose to solve their marital conflicts reflect the ways in which any living creature reacts to an uncomfortable stimulus. It becomes aggressive and tries to eliminate the irritant, or it accepts the situation and tries to adjust itself to bear it, or it finally takes recourse in flight. The first type of reaction is manifested by the advice sought on how to operate on the husband or the other individuals concerned. These women ask, for example, what to do to make their husbands love them, or what to do to be rid of the other woman, the in-laws, etc. A passive acceptance of the situation is manifested by the request for comfort or solace. The flight reaction, which is here manifest by the desire to separate or divorce, is suggested by some of the women in an unconditional tone. By others it is considered but discarded for certain specified reasons.

Among these women, 26.7 percent express a desire to correct the situation, 23.6 percent accept it, 21.6 percent would separate or divorce except for some stated reason, and 28.2 percent intend to, or have already separated or divorced. The frequencies of these types of reaction in relation to the stated element of conflict are shown in Table 5.

TABLE 5

Percentage of women with specified overt reactions to stated elements of marital conflict

ELEMENTS OF CONFLICT	OVERT REACTIONS: Separation or divorce — Effected or considered without reservations	Separation or divorce — Considered but discarded for specified reasons	Passive resignation	Desire to correct the situation	TOTAL	NO. OF WOMEN
	Percentage					
Masculine domination	18.8	21.3	32.5	27.5	100.1	80
In-laws	19.4	5.6	36.1	38.9	100.0	36
Infidelity	24.4	30.1	21.1	24.4	100.0	123
Affective maladjustment	29.2	22.2	18.1	30.6	100.1	72
Sex.-Repro. Disharmony	33.3	14.3	28.6	23.8	100.0	21
Social vices	46.7	20.0	6.7	26.7	100.1	30
Non-support	57.1	10.7	21.4	10.7	99.9	28
All elements	28.2	21.6	23.6	26.7	100.1	390

It appears from Table 5 that when masculine domination is the primary element of the conflict, the desire to disrupt the marriage is much less in evidence than it is in the case of other difficulties. The same result is also noted for the difficulties that arise from interference by the in-laws. These are the troubles that more often lead to a desire to remedy the situation. On the other hand the women who complain of non-support and the husband's social vices react more often by a desire to separate or divorce than do the remaining women. Only 18.8 percent of the women who complain of masculine domination and 19.4 percent of the women troubled by the husband's kinsfolk consider or have effected separation. In contrast, this reaction is manifest by 57.1 and 46.7 percent respectively of the women whose marital conflicts are attributed to non-support and social vices.

Among the reasons given for not wanting a separation or divorce, the need for support and the effect of divorce on the moral development of the children are the most frequent. Of the 84 women who have

considered but discarded the idea of breaking the marriage, 34 or 40.5 percent give the first reason as justification and 42 or 50 percent give the second. Religious or ethical scruples about divorce itself overtly play a very secondary part in the decision of these women, since it is alleged by only 9.5 percent. It should not be overlooked, however, that religious and ethical scruples may form no small part in the passive resignation type of reaction.

On the whole then, these data would indicate that the conflicts which more often tend to disrupt the marriage are those which arise from problems regarding the material aspects of life. In this respect, it might be added that the complaints caused by the husband's drinking and gambling apparently are not at all concerned with the moral or financial phase of these habits. Instead the women deplore the lack of physical companionship which is a consequence of this behavior. Conflicts arising from personality clashes directly between husbands and wives or indirectly due to interference by the in-laws are frequent, but as contributory causes of the breakdown of the marital group they are apparently less effective than those related to the fundamental necessities of life. With reference to the relative frequency of each type of reaction, the differences to be noted among the women complaining of affective maladjustment, sexual-reproductive disharmony, infidelity, and in-laws may be entirely due to chance. It would seem then that in the determination of the form of reaction there are factors of at least equal importance to those implicit in the above elements of conflict.

Reaction to conflict and age and duration of marriage

As it is to be expected from the knowledge at hand about divorce, the women in this sample who consider or have effected separation or divorce are somewhat younger than the remainder. However, when the size of the sample is taken into account, the differences are not significant statistically and therefore have been omitted. It is observed that 50 percent of the women below 20 years of age definitely desire to disrupt their marriage while this is true for only 27.5 percent of the women 40 years and over. This difference, however, may be due to chance. The association between duration of marriage and tendency to separate or divorce appears, on the other hand, to be significant.

From Table 6 it is seen that the duration of marriage is least for the women who react by separation, and highest for the women who would separate but feel they cannot or should not. Moreover among

TABLE 6

Marriage duration and overt reaction to marital conflict

OVERT REACTION TO MARITAL CONFLICT	MEAN MARRIAGE DURATION (*in years*)	NO. OF WOMEN
Separation or divorce effected or considered without reservations	7.9	81
Separation or divorce considered but discarded, reasons given...	11.8	65
Passive resignation	10.2	53
Desire to correct situation.....	8.6	80
All reactions	9.3±.3	279

the women with less than five years of married life, 35.8 percent definitely consider separation or divorce while this is true for only 17.9 percent of the women married for over 15 years. This difference is apparently not due to chance.

These findings are in agreement with the well-known fact that in the earliest years of marriage there is greater risk of a disruption of the marital ties than in the later years. As the marriage lasts longer, the chances of habituation and of having children increase. The woman acquires a certain degree of societal isolation and the desire or the ability to start a new form of social life are much reduced. These facts will appear in a more striking fashion in the next section.

Reaction to conflict and independent means and other love interests

As for the elements of conflict, the women who have means of support other than their husbands demonstrate a different reaction pattern than other women.

From Table 7 it will be noted that 46.2 percent of the women with independent means and only 28.2 percent of the whole sample of women propose a solution of their marital problems by means of separation or divorce. It will also be noted that 14.4 percent of the former and 26.7 percent of the latter desire to know what to do to correct the situation.

TABLE 7

Frequency of types of reaction to marital conflicts in women with independent means and other love interests

OVERT REACTION TO MARITAL CONFLICT	ALL WOMEN		WOMEN WITH INDEPENDENT MEANS		WOMEN WITH OTHER LOVE INTERESTS	
	No.	*Percent*	*No.*	*Percent*	*No.*	*Percent*
Separation or divorce effected or considered without reservations	110	28.2	48	46.2	26	74.3
Separation or divorce considered but discarded, reasons given	84	21.6	17	16.3	6	17.1
Passive resignation	92	23.6	24	23.1	1	2.9
Desire to correct situation	104	26.7	15	14.4	2	5.7
All reactions	390	100.1	104	100.0	35	100.0

A chi-square test indicates that these differences are apparently not due to chance.

Of the 35 women who are interested in another man, 74.3 percent definitely want separation or divorce as compared to the 28.2 percent of the whole sample of women. Again we are dealing with differences which are statistically significant.

The above results emphasize once again the importance of the fundamental material factors in the persistence as well as the disruption of the marital union. They serve also to explain the relation of the frequency of disruption of marriage to age and marriage duration. The woman who is young enough to attract other men or to obtain an occupation, and the woman who has independent means or another man to replace the husband have a lessened desire or need to continue the marriage under difficult conditions, or to attempt to find some remedy for marital dissatisfactions.

SUMMARY

A study of the intra-marital problems of 390 married women reveals:

1. The most frequent element of conflict is the husband's unfaithfulness. Next in order of frequency are the conflicts attributed to

maladjustment of the affective relations, followed by the problems which arise from the tendency on the part of the husband to dominate the actions and behavior of the wife. Altogether these three factors are responsible for about 70 percent of the conflicts. Of little numerical importance appear to be the difficulties concerning the economic and sexual-reproductive aspects of marriage.

2. There is a definite relationship between age and marriage duration on the one hand, and on the other hand between the frequency of affective maladjustment and infidelity. Among the younger women affective maladjustment is a predominant complaint while infidelity is infrequently reported. In contrast, among the older women infidelity is the main source of conflict, affective maladjustment the least.

3. Women who have a means of getting a living other than dependence on the husband differ from the remaining women by an increased tendency to complain of domination by the husband. Women who have another male love interest complain about affective maladjustment more than other women.

4. In about equal number, these women manifest the following types of reaction to their problems: (1) desire to correct the situation, (2) passive resignation, (3) definite intention to separate or divorce, (4) consideration of separation or divorce which, however, will not be effected for stated reasons.

5. The women who complain of marital domination, affective maladjustment, infidelity and interference by in-laws are the ones who, proportionately to their numbers, manifest least often a definite intention to separate or divorce. In contrast, those women whose conflicts arise from non-support, sexual-reproductive maladjustment or the husband's social vices are the ones who demonstrate most often the intention to disrupt the marriage.

6. The duration of marriage is on the average shorter among the women who intend to separate or divorce than among the others.

7. Women who do not depend upon their husbands alone for their means of living or else have other male love interests demonstrate an intention to separate or divorce two or three times more often than the other women.

DISCUSSION

This study was undertaken with two objectives in mind: (1) to give a concrete illustration of some of the arguments advanced regarding the approach to the study of human social biology; and (2) to acquire a better understanding of the factors involved in the disruption and persistence of the marital group. The characteristics of the material are, of course, the factors which limit the degree of achievement of the objectives.

It is noted, first of all, that even though all these women are unhappily married and although the laws and mores allow a certain amount of individual freedom of action, still the majority of the women, over 70 percent, have no intention of breaking their marital ties. Moreover, the number of women who desire to take active steps to correct the situation and eliminate the conflict is greater than the number of those who apparently have a definite desire to end the marital union. These facts alone would support the idea that marriage cannot be regarded simply as a manifestation of man's acquiescence to social pressure. Its far deeper foundation is so obvious that only few of the women express the need to rationalize about their desire to stay married or to justify this desire by introducing religious or ethical principles.

The reaction to the conflict induced apparently by the husband's inability to provide a living seems to be the one main exception to the general attitude of these women. This exception might suggest then that the deep sentiment which is causally connected with the persistence of the marital group is actually secondary to the question of material well-being. Such an inference, in the form presented, would be inadequate and also partially incorrect as can be judged from general evidence regarding human behavior. Another inference seems more appropriate. It is that the importance of non-support as a disruptive factor in marriage is an indication of the primary rôle attributed to the husband as a provider of the means of living. The validity of this inference is corroborated here by the observation that when the husband's provider rôle becomes secondary, the marriage also tends to be disrupted whether or not there is actual want. Such is the case when women have independent means, and also, in part, when they have another man to replace the husband.

Continuing along this line of reasoning, it will be noted that non-support while important as a disruptive factor in marriage, is among the least frequent as an element of conflict. It will also be noted that

sexual-reproductive disharmony is infrequently mentioned as an element of conflict, yet more often than the other elements it leads to separation and divorce. It will be noted also that the three elements of conflict occurring most frequently (infidelity, masculine domination, and affective maladjustment) are also those which in general are less apt to lead to separation or divorce. Considering all these facts it seems legitimate to conclude that they indicate which are the fundamental elements in the rôle of husband in the marital group. It is reasoned here that the relative prevalence of elements of conflict indicates their prevalence in general; and that the least frequent as causes of conflict and most frequent as causes of disruption are those more essential for the persistence of the marital group. From the data at hand it is found that these elements are the husband's rôle as a provider of the means of living, as a sexual partner, as father, and as a physical companion. These apparently are the most important requisites affecting the position of the husband in the marital group. That this group should form a unit independent from the families of each of the marital partners is also an important characteristic of marriages. But apparently the ties of affection which unite each individual to his family are not a necessary element for the persistence of the group. Masculine domination is relatively frequent as an element of conflict and therefore it seems justifiable to conclude that domination on the part of the husband is general and accepted if not conceded. Using the same criterion it appears that affection is demanded most in youth, but with the probable exception of its function in matrimonial selection, it has limited importance in the marital union. Finally, from the data here reported it would seem that polygamous tendencies are very much in evidence but relatively unimportant with respect to the reaction of the wife.

This outline of the relative importance of the several elements of interaction in the marital group is unilateral because it is limited principally to the rôle of the husband. Neither can it serve to describe completely the qualities of the group because there is no information available regarding the personality of the individuals. The seriousness of this defect is only too evident when it is considered that the elements of conflict may arise from the *relative* standards of a certain trait, that is, relative to the other partner. Sexual disharmony, for example, derives not from absolute frigidity or hypersexuality but from a difference in sexuality between the two partners. If *both* are frigid or alternatively are over-sexed disharmony on this score is unlikely to

exist. It is not necessary to labor this point further but it should be kept in mind with regard to all the elements of conflict.

From this schematic and unilateral view of the fundamental factors in the marital group interaction it could probably be said that marriage is essentially an economic and sexual-reproductive union. The contemporary marital group is based therefore on those traits which man shares with other living creatures. Notwithstanding this the human mating differs from that of other animals not only because of the so-called superorganic factors, but because in man the economic, sexual-reproductive, and companionship factors are all at the same time actually or potentially manifest. The observations compiled by Westermarck and Briffault demonstrate this very clearly. If the works of these two authors are viewed in this light it will be seen that, once the concepts of the suggested primeval pattern are discarded, their studies bear on the development of marriage in terms of the coexistence of the economic and sexual-reproductive factors. When carefully examined, the efforts of the laws and the mores are seen to be directed principally towards maintaining the importance of these factors. As the inefficacy of the laws enacted during the period of the Roman empire well demonstrate, they can do no more because the survival of the marital group or of any group in one form or another does not depend upon the laws but upon the individuals who form the group.

REFERENCES

BRIFFAULT, R. 1931. The Mothers. The Matriarchal Theory of Social Origins. *New York* (The Macmillan Co.).

BROMLEY, D. D., and F. H. BRITTEN. 1938. Youth and Sex. A Study of 1300 College Students. *New York* (Harper and Brothers).

CAHEN, A. 1932. Statistical Analysis of American Divorce. *New York* (Columbia University Press).

CIOCCO, A. 1938. On human social biology. I. Preliminary remarks. *Quart. Rev. Biol.*, Vol. 13, No. 4.

CUNNINGHAM, B. V. 1936. Family Behavior. A Study of Human Relations. *Philadelphia* (W. B. Saunders Co.).

DAVIS, K. B. 1929. Factors in the Sex Life of Twenty-two Hundred Women. *New York* (Harper and Brothers).

DICKINSON, R. L., and L. BEAM. 1931. A Thousand Marriages. A Medical Study of Sex Adjustment. *Baltimore* (Williams and Wilkins Co.).

GOODSELL, W. 1934. A History of Marriage and the Family. Revised Edition. *New York* (The Macmillan Co.).

GROVES, E. R. 1934. The American Family. *Chicago* (J. B. Lippincott Co.).

————, and W. F. Ogburn. 1928. American Marriage and Family Relationships. *New York* (H. Holt and Co.).

Hamilton, G. V. 1929. A Research in Marriage. *New York* (A. and C. Boni, Inc.).

Lumpkin, K. D. 1933. The Family. A Study of Member Rôles. *Chapel Hill* (The University of North Caroiina Press).

Mowrer, E. R. 1932. The Family. Its Organization and Disorganization. *Chicago* (The University of Chicago Press).

————, and H. R. Mowrer. 1928. Domestic Discord: Its Analysis and Treatment. *Chicago* (The University of Chicago Press).

Mowrer, H. R. 1935. Personality Adjustment and Domestic Discord. *New York* (American Book Co.).

Nimkoff, M. F. 1934. The Family. *Boston* (Houghton, Mifflin and Co.).

de Pomerai, R. 1930. Marriage: Past, Present and Future. *New York* (R. R. Smith, Inc.).

Van de Velde, T. H. 1934. Fit or Unfit for Marriage. *London* (Chapman and Hall, Ltd.).

Westermarck, E. 1925. The History of Human Marriage. 5th Edition. *London* (Macmillan and Co., Ltd.).

————. 1934. Three Essays on Sex and Marriage. *London* (Macmillan and Co., Ltd.).

————. 1936. The Future of Marriage in Western Civilization. *New York* (The Macmillan Co.).

NOTES

BEAUTY, MARRIAGE AND FERTILITY

IN HUMAN BIOLOGY, Vol. 10, No. 1, a study by S. J. Holmes and C. E. Hatch has been published on "Personal appearence as related to scholastic records and marriage selection in college women".

At page 73 the authors complain that "about the only study on the relation of beauty to marriage selection that we could find was made by Miss C. F. Gilmore and described in an unpublished thesis for the Master's degree at the University of Pittsburgh". I suppose they say "about" because of another study by Miss J. O. Naly on "Facial appearance and other factors in mate selection among college graduates" quoted by S. J. Holmes in his work *Trend of the Race.*

But a far more important research on this subject has been made in Italy, at my suggestion, by Dr. C. Grillenzoni. The study entitled "I caratteri del fisico e del vestire come fattori demografici" ("Physical characteristics and dress as demographic factors") was published in *Metron*, Vol. X, No. 3, 1932. The two studies by Miss Gilmore and Miss Naly are duly referred to in a note of mine to the first page of the article.

The data examined by Grillenzoni are different from those considered by Holmes and Hatch; they refer to 1500 women from various social classes, from about 30 to about 60 years of age. Grillenzoni has not selected very young women because he not only has examined beauty and smartness as a factor of marriage selection, but has also studied the relations between these factors and fertility.

I shall not report here the author's conclusions relating to the influence of smartness on marriage and on fertility, but only those relating to the influence of beauty on marriage and fertility.

Beauty appears to have a positive influence on marriage; as a matter of fact the average marrying age of the more beautiful women is much lower (22.7) than that of the less beautiful ones (26.0). Further, the average degree of beauty of unmarried women is lower than the average degree of beauty of married women.

The effects of beauty on fertility are less noticeable though a slight negative correlation exists between the two characteristics. The average number of children born from the less beautiful women is 3.09; it decreases when the degree of beauty increases and it attains 2.56 for the more beautiful women.

Not only the general physical features but also some special physical characteristics seem to have an influence on marriage rate and on fertility. As regards figure, any deviation from the regular type has an unfavorable influence on both, thick-set women being at a special disadvantage as compared with slim women.

As for height, tall women seem to have a greater probability of getting married; on the other hand, women of low stature show a higher fertility.

A further interesting result of Grillenzoni's study is the existence of a remarkable degree of homogamy between individuals of a similar degree of beauty.

I think that these conclusions may be of some interest for the readers of HUMAN BIOLOGY; they agree with those of Holmes and Hatch as regards the influence of beauty on marriage selection and they throw some light on another problem which those authors regret they could not study on the basis of their data, that is: the relation of beauty to fertility.

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ANTHOLOGIA ANTHROPOLOGICA

IT IS a matter of great interest to all anthropologists and students of human biology that the working notebooks of Sir James G. Frazer, O.M., F.R.S., F.B.A., author of *The Golden Bough, Totemism and Exogamy,* etc., are to be published, and thus made generally available. In fact by the time this note appears it is expected that the first volume in the series will have been issued. The title of this first volume is *Native Races of Africa and Madagascar.* The publisher is Percy Lund, Humphries and Co., Ltd., 12 Bedford Square, London, W. C. 1, England. The

price to pre-publication subscribers was 30s, and to others 35s. Later volumes will deal with Australia, Oceania and Indonesia, Asia, and America and Europe.

The material consists of quotations from all manner of first-hand accounts, by travellers, hunters, missionaries and scientists, from the fifteenth to the twentieth century. In Sir James's preface to the first volume the significance of the enterprise is indicated in the following words:

> The books from which I have drawn the contents of this anthology are written for the most part in a plain straightforward way, the authors contenting themselves with describing in simple language the things which they have seen, or had heard reported by competent native informants. Few if any of them possess that magic charm of style which, by firing the imagination or touching the heart, can alone confer what we fondly call immortality upon a work of literature. Probably, therefore, many of them will never be reprinted, and consequently, through the inevitable effects of time and chance, the numbers of extant copies will gradually dwindle away and at the same time, like the Sibylline leaves, attain an enhanced value by their very rarity, as solitary records of a vanished past, till, when the last copy has disappeared, memory of the lost originals may be preserved only through some scanty quotation or brief allusion to an antiquarian handbook or dictionary of antiquities. If that time should ever come, it may be that when my own writings have undergone the common fate of old books by being consigned to the lumber-room or the dust-heap and forgotten, I may still be remembered as the compiler of a useful anthology of Social Anthropology.

All human biologists will rejoice with us that this superb material, the working apparatus of a great scholar, is to become generally available through these volumes.

R. P.

SECTIONAL ISSUANCE OF BIOLOGICAL ABSTRACTS—PLAN FOR 1939

THE emergency subsidy plan for *Biological Abstracts* which was in effect throughout 1938 will be abandoned at the close of the current year. A plan has been evolved whereby *Biological Abstracts,* while continuing to appear as a single complete entity, might, without repaging or other change except in the cover, be also broken up into several subject groups which would be made available to individuals not desiring the complete service. The idea

seems practicable and the following subject grouping into five "reprint" parts is adopted for 1939.

I. *Abstracts of General Biology* to include General Biology, Biography-History, Bibliography, Evolution, Cytology, Genetics, Biometry, and Ecology; price $4.

II. *Abstracts of Experimental Animal Biology* to include Animal Physiology, Nutrition, Pharmacology, Pathology, Anatomy, Embryology, and Animal Production; $9.

III. *Abstracts of Microbiology and Parasitology* to include Immunology, Bacteriology, Viruses, Parasitology, Protozoology, and Helminthology; $5.

IV. *Abstracts of Plant Sciences* to include Phytopathology, Plant Physiology, Plant Anatomy, Paleobotany, Systematic Botany, Agronomy, Horticulture, Forestry, Pharmacognosy, and Pharmaceutical Botany; $6.

V. *Abstracts of Animal Sciences* to include Paleozoology, Parasitology, Protozoology, and Helminthology, Systematic Zoology, and Economic Entomology; $6.

As in the past, members of societies contributing $2 or more per person to *Biological Abstracts* will be entitled to (a) deduct the contribution from a sectional or volume subscription, or (b) receive the complete index.

The subscription price for the complete volume 13 for 1939 will be $25 to individual subscribers and institutions alike.

A plan of this nature would involve merely the lifting out (without resetting of type or renumbering of the abstracts) of the sections appertaining to the subject group concerned and binding them in a separate cover which would bear the appropriate subtitle. This procedure would undoubtedly be facilitated by rearrangement of some of the sections. The complete index, going to all subscribers, would still preserve most of the desirable long-range features of the full service, and especially so since all subscribing libraries and institutions will, of course, want *Biological Abstracts* in its entirety. This would meet the requirements alike of specialization and general survey at prices that will be found feasible by both biologists and libraries. It is most emphatically not proposed to destroy *Biological Abstracts* by breaking it up into its components, but rather to maintain it as an integral unit while offering

the membership of the separate societies many of the advantages which they would have if each society had its own individual abstracting journal.

Coverage will be prompt, as also the issues of indexes. The aim is a lag of no more than two months, and index in the spring. The extent of coverage must, of course, depend on the extent of support. Biologists can get only what they pay for. With no national society treasury to draw upon, this must be so. At least 1250 subscriptions to the complete edition, and four times as many orders for section issues, are required to make possible publication without deficit. Libraries can be depended on to provide the former. Is it too much to expect an average of 1000 individual subscribers to each section?

Each of the biological societies concerned is being invited to set up a committee which will be effective in fixing the editorial policies and standards of the *Abstracts* within its respective field.

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RECENT LITERATURE

USEFUL IN THE STUDY OF HUMAN BIOLOGY

In this department will be noticed the books and reprints which are currently received at the Editorial Office. Publications intended for notice here should be addressed to Dr. Raymond Pearl, Department of Biology, School of Hygiene and Public Health, 1901 East Madison Street, Baltimore, Maryland, U.S.A.

I. EVOLUTION AND GENETICS

1. *Evolution—General Principles*

DE BEER, G. R. [Editor]. Evolution. Essays on Aspects of Evolutionary Biology Presented to Professor E. S. Goodrich on His Seventieth Birthday. *New York* (Oxford University Press); *Oxford* (Clarendon Press), 1938. Pp. viii + 350. 8¾ × 5½ inches. $5.00. [Bibliography at the end of each essay, and list of "Scientific Works of E. S. Goodrich" of 3½ pages.]

DEWAR, DOUGLAS. More Difficulties of the Evolution Theory and a Reply to "Evolution and Its Modern Critics". *London* (Thynne and Co.), 1938. Pp. [12] + 206 + [9]. 8s. 6d. [List of "References to Books Frequently Quoted", of 11 titles.]

DOBZHANSKY, TH. Genetic nature of species differences. *American Naturalist*, Vol. 71, pp. 404-420, 1937. [Bibliography of 21 titles.]

DOBZHANSKY, TH. What is a species? *Scientia*, T. 61, pp. 280-286, 1937.

FORTUYN, A. B. DROOGLEEVER. Our common interest. *Peking Natural History Bulletin* Inset Vol. 12, pp. xvii-xx, 1937.

GRAY, ALBERT A. The Basis of Tissue Evolution and Pathogenesis. *Glasgow* (Jackson, Son and Co.), 1937. Pp. xix + 92. 9½ × 5¼ inches. 7s. 6d. [Bibliographic footnotes.]

HEUSS, EUGEN. Rationale Biologie und Ihre Kritik. (Eine Auseinandersetzung mit dem Vitalismus H. Driesch's). *Leipzig* (Verlag von S. Hirzel), 1938. Pp. ix + 192. 9¾ × 6⅝ inches. RM. 6 (paper). [Bibliographic footnotes.]

KOSTITZIN, V. A. Sélection naturelle et transformation des espèces du point de vue analytique, statistique et biologique. *C. r. des Séances de l'Académie des Sciences, Paris*, T. 206, pp. 1442-1444, 1938. [3 bibliographic footnotes.]

NABOURS, ROBERT K. Species from the generic standpoint. *American Naturalist*, Vol. 70, pp. 191-192, 1936.

REINIG, W. F. Elimination und Selektion. Eine Untersuchung über Merkmalsprogressionen bei Tieren und Pflanzen auf genetisch- und historisch-chorologischer Grundlage. *Jena* (Gustav Fischer), 1938. Pp. viii + 146. 10 × 6¾ inches. RM. 8 (paper). [Bibliography of 5½ pages.]

ROBB, R. CUMMING. A study of mutations in evolution. I. Evolution in the equine skull. II. Ontogeny in the equine skull. *Journal of Genetics*, Vol. 31, pp. 39-52, 1935. [16 bibliographic references to Part I; 7 bibliographic references to Part II.]

ROBB, R. CUMMING. A study of mutations in evolution. III. The evolution of the equine foot. IV. Ontogeny of the equine foot. *Journal of Genetics*, Vol. 33, pp. 267-273, 1936; and Vol. 34, pp. 477-486, 1937. [5 bibliographic references to Part III; 32 bibliographic references to Part IV.]

2. *Human Evolution*

DUNBAR, SIR GEORGE. Other Men's Lives. *London* (Nicholson and Watson, Ltd.), 1938. Pp. xi + 355. 8¼ × 5½ inches. 10s. 6d. net. [Bibliographic footnotes.]

GUMBEL, E. J. La prévision des inondations. *C. r. des Séances de l'Académie des Sciences*, T. 206, pp. 558-560, 1938. [5 bibliographic footnotes.]

3. *Prehistory and Archaeology*

HEIZER, ROBERT F. A complete atlatl dart from Pershing County, Nevada. *New Mexico Anthropologist*, Vol. 2, pp. 70-71, 1938. [4 bibliographic footnotes.]

HOCHHOLZER, HANS. Zur vor- und frühgeschichtlichen Rassen- und Kulturgeographie der Italiker und Illyrer. *Zeitschrift für Rassenkunde*, Bd. 8, pp. 1-26, 1938. [Bibliographic footnotes.]

SARASIN, F. Über Spuren einer früheren weddiden Bevölkerung auf der Insel Roti oder Rote bei Timor. *Zeitschrift für Rassenkunde*, Bd. 7, pp. 251-254, 1938. [Bibliography of 5 titles.]

4. *Genetics—General Principles*

BLUHM, AGNES. Über erworbene Immunität, Giftüberempfindlichkeit und Vererbung. Ein Beitrag zur Frage der Dauermodifikationen. *Archiv für Rassen- und Gesellschaftsbiologie*, Bd. 32, pp. 97-110, 1938. [Bibliographic footnotes.]

CREW, F. A. E. The sex ratio. *Proceedings of the British Association for the Advancement of Science, Nottingham*, September, 1937, pp. 95-114. [Bibliography of 2½ pages.]

GOLDSCHMIDT, RICHARD. The time-law of intersexuality. *Genetica*, Vol. 20, pp. 1-50, 1938. [Bibliography of 28 titles.]

GOLDSCHMIDT, RICHARD. Intersexuality and development. *American Naturalist*, Vol. 72, pp. 228-242, 1938. [Bibliography of 8 titles.]

KOSTITZIN, V. A. Sur les coefficients mendeliens d'hérédité. *C. r. des Séances de l'Académie des Sciences, Paris*, T. 206, pp. 883-886, 1938. [5 bibliographic footnotes.]

LITTLE, C. C., and STANLEY P. REIMANN. Dialogue on the relations of genetics and experimental embryology to neoplasia. *American Journal of Clinical Pathology*, Vol. 8, pp. 109-119, 1938.

MATHER, K. The Measurement of Linkage in Heredity. *New York* (Chemical Publishing Co. of New York), 1938. Pp. ix + 132. 6½ × 4 inches. $1.75. [Bibliography of 28 titles.]

WALTER, HERBERT E. Genetics. An Introduction to the Study of Heredity. Fourth Edition. *New York* (The Macmillan Co.), 1938. Pp. xvii + 412. 8½ × 5¾ inches. $3.00. [Bibliography of 6¼ pages.]

5. *Human Heredity*

DICE, LEE R. A proposed laboratory for the study of human heredity in Michigan. *Thirty-eighth Annual Report of the Michigan Academy of Science, Arts and Letters*, pp. 84-87, 1937.

ESKELUND, VIGGO. Structural Variations of the Human Iris and Their Heredity with Special Reference to the Frontal Boundary Layer. *Copenhagen* (Nyt Nordisk Forlag, Arnold Busck); *London* (H. K. Lewis and Co.), 1938. Pp. 242 + [1]. 10 × 7½ inches. 21s. net (paper). [Bibliography of 12 titles.]

GOLDSCHMIDT, RICHARD. "Progressive Heredity" and "Anticipation". *Journal of Heredity*, Vol. 29, pp. 140-142, 1938. [Bibliography of 6 titles.]

LOMBARD, HERBERT L. Studies on the familial aspects of cancer. *New England Journal of Medicine*, Vol. 218, pp. 711-713, 1938.

READ, FRANCES E. M., ANTONIO CIOCCO, and HELEN B. TAUSSIG. The frequency of rheumatic manifestations among the siblings, parents, uncles, aunts and grandparents of rheumatic and control patients. *American Journal of Hygiene*, Vol. 27, pp. 719-737, 1938. [Bibliography of 18 titles.]

ROBB, R. CUMMING. The relative frequency of inheritable disorders in children. *Genetics*, Vol. 22, p. 205, 1937.

ROBB, R. CUMMING. The relative frequency of fifty commonly inherited disorders of childhood. *Eugenical News*, Vol. 22, pp. 3-6, 1937. [Bibliography of 11 titles.]

SCHWIDETZKY, I. Rassenbildung und Mathematik. *Zeitschrift für Rassenkunde*, Bd. 7, pp. 299-302, 1938. [5 bibliographic footnotes.]

WELLISCH, S. Rassendiagnose der Ungarn. *Zeitschrift für Rassenkunde*, Bd. 8, pp. 32-41, 1938. [Bibliography of 10 titles.]

WIENER, ALEXANDER S. Medicolegal applications of blood grouping. *Revista "Vida Nueva"*, T. 42, No. 2. Pp. (of reprint) 31. [In English and Spanish.]

6. *Eugenics*

CREW, F. A. E. Improving humanity. *The Spectator*, May 21, 1937. Pp. (of reprint) 1.

II. GROUP BIOLOGY

1. *Environment of Man*

AUFRÈRE, L., F.-S. BODENHEIMER, A. CHEVALIER, L. CHOPARD, L. EMBERGER, H. FOLEY, H. GAUTHIER, L. JOLEAUD, CH. KILLIAN, D. FÉHER, R. MAIRE, TH. MONOD, P. DE PEYERIMHOFF, A. REYMOND, L.-G. SEURAT, P. TEILHARD

DE CHARDIN, B.-P. UVAROV, B. ZOLOTAREVSKI, and M. MURAT. La Vie dans la Région Désertique Nord-Tropicale de L'Ancien Monde. *Société de Biogéographie* VI. *Paris* (Paul Lechevalier), 1938. Pp. 406. 10 × 6⅝ inches. 175 francs (paper). [Bibliography at the end of each article.]

BERCAW, LOUISE O., ANNIE M. HANNAY, and MARY G. LACY. Bibliography on Land Utilization, 1918-36. *U.S. Department of Agriculture. Miscellaneous Publication* No. 284. *Washington* (Government Printing Office), 1938. Pp. iv + 1508. 9¼ × 5⅞ inches. $1.50 (paper).

CASTELLANI, SIR ALDO. Climate and Acclimatization. Some Notes and Observations. *London* (John Bale, Sons and Curnow, Ltd.), 1938. Pp. ix + 198. 7¼ × 4¾ inches. 10s. net. [Bibliography of 11½ pages.]

ELLIS, CARLETON, and MILLER W. SWANEY. Soilless Growth of Plants. Use of Nutrient Solutions, Water, Sand, Cinder, Etc. *New York* (Reinhold Publishing Corporation), 1938. Pp. 155. 9 × 6 inches. $2.75.

GUMBEL, E. J. La distribution des inondations. *Aktuárské Vědy Pojistná Matematika, Matematická Statistika*, T. 7, pp. 85-93, 1937-1938. [Bibliography of 12 titles.]

MCINERNY, A. J. Through the Great Arid Filter (Man's Drift to Europe). *Otley, Yorks, England* (A. J. McInerny), 1938. Pp. 46. 8⅜ × 5½ inches. 2s. (paper). [Bibliographic footnotes.]

NEW YORK HERALD TRIBUNE HOME INSTITUTE. America's Cook Book. *New York and London* (Charles Scribner's Sons), 1938. Pp. xvi + 1006. 8¼ × 5½ inches. $2.50.

RENNER, F. G., EDWARD C. CRAFTS, THEO C. HARTMAN, and LINCOLN ELLISON. A Selected Bibliography on Management of Western Ranges, Livestock, and Wildlife. *U.S. Department of Agriculture. Miscellaneous Publication* No. 281. *Washington* (Government Printing Office), 1938. Pp. ii + 468. 9¼ × 6 inches. 45 cents (paper).

2. *Public Health and Hygiene*

BRITISH COLUMBIA, Province of. Forty-first Report of the Provincial Board of Health for the Year Ended December 31, 1937. *Victoria*, 1938. Pp. 41. 10½ × 7½ inches.

BURRITT, BAILEY B. Social and economic problems in the control of tuberculosis. *Milbank Memorial Fund Quarterly*, Vol. 16, pp. 287-293, 1938.

KLEIN, HENRY, and CARROLL E. PALMER. The dental problem of elementary school children. *Milbank Memorial Fund Quarterly*, Vol. 16, pp. 267-286, 1938. [Bibliography of 27 titles.]

NEW YORK STATE DEPARTMENT OF HEALTH. Annual Report of the Division of Laboratories and Research. *Albany*, 1937. Pp. 114 + 1 folding chart. 9 × 5¾ inches.

RICE, JOHN L., and MARGARET W. BARNARD. Four years of district health administration in New York City. *Milbank Memorial Fund Quarterly*, Vol. 16, pp. 253-266, 1938.

ROTHERT, FRANCES C. Recent developments in the maternal and child-health and crippled children's programs in the southern states. *Southern Medical Journal*, Vol. 31, pp. 692-697, 1938.

3. *Migration*

KÜNSTLE, G. Die Abwanderung der Begabten vom Dorf. Eine Untersuchung über die Abwanderung der gut-, mittel- und schlechtbegabten Schulkinder eines Schwarzwalddorfes der Geburtsjahrgänge 1870-1919. *Zeitschrift für Rassenkunde,* Bd. 7, pp. 281-288, 1938.

MOLINARI, A. Statistique du tourisme international. Rapport de la Commission de la statistique des migrations. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 12. [Bibliographic footnotes.]

SMUTNÝ, P. Méthode-frontière dans la statistique du tourisme. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 7. [1 bibliographic footnote.]

4. *Population*

BUXTON, P. A. Studies on populations of head-lice (*Pediculus humanus capitis*: Anoplura). II. *Parasitology,* Vol. 30, pp. 85-110, 1938. [Bibliography of 14 titles.]

CHAO, CH'ENG-HSIN. Recent population changes in China. *Yenching Journal of Social Studies,* Vol. 1, pp. 1-48, 1938. [Bibliographic footnotes.]

CONGRÈS INTERNATIONAL DE LA POPULATION. PARIS 1937. Vol. I Théorie Générale de la Population; Vol. II Démographie Historique; Vol. III Démographie Statistique. Études d'Ensemble; Vol. VI Démographie de la France d'Outremer. *Paris* (Hermann et Cie), 1938. Vol. I, pp. 270; Vol. II, pp. 105; Vol. III, pp. 155; Vol. VI, pp. 128. 10 × 6½ inches. [Bibliographic footnotes to some articles.]

HALL, R. P. Effects of manganese on the growth of *Euglena anabaena, Astasia* sp. and *Colpidium campylum. Archiv für Protistenkunde,* Bd. 90, pp. 178-184, 1937. [Bibliography of 12 titles.]

HALL, R. P., and H. W. SCHOENBORN. Studies on the question of autotrophic nutrition in *Chlorogonium euchlorum, Euglena anabaena and Euglena deses. Archiv für Protistenkunde,* Bd. 90, pp. 259-271, 1938. [Bibliography of 21 titles.]

HICKLING, C. F. The English Plaice-Marking Experiments 1929-1932. Fishery Investigations, Series II, Volume 16, Number 1. *London* (H. M. Stationery Office), 1938. Pp. 84. 10¾ × 7 inches. 4s.; (Obtainable in North America from British Library of Information, New York) $1.25 (paper). [Bibliography of 22 titles.]

HOGBEN, LANCELOT [Editor]. Political Arithmetic. A Symposium of Population Studies. *New York* (The Macmillan Co.), 1938. Pp. 531. 9¼ × 6 inches. $9.00. [Bibliography or bibliographic footnotes to some of the chapters.]

JANKO, J. Le taux annuel d'accroissement de la population. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 6.

TAYLOR, CARL C., and CONRAD TAEUBER. Constructive rural farm population policies. *Milbank Memorial Fund Quarterly,* Vol. 16, pp. 233-252, 1938. [Bibliographic footnotes.]

VOÛTE, A. D. Bevolkingsproblemen III. (With English summary). *Natuurkundig Tijdschrift voor Nederlandsch-Indië*, Afl. 2, Deel 98, pp. 97-102, 1938. [Bibliography of 2 titles.]

5. *Mortality and General Vital Statistics*

BUREAU OF THE CENSUS. *Vital Statistics—Special Reports, Washington, D. C.* Various numbers as follows:

Provisional mortality statistics for 1937. Vol. 5, No. 32, June 15, 1938, pp. 113-118.

Provisional summary of infant mortality for 1937. Vol. 5, No. 33, June 15, 1938, pp. 119-126.

Fatal accidents in the United States: 1936. Vol. 5, No. 34, June 21, 1938, pp. 127-152.

Maternal mortality: United States. Vol. 5, No. 36, June 9, 1938, pp. 161-170.

Infant mortality: United States. Vol. 5, No. 37, July 13, 1938, pp. 171-184.

Number of deaths from tuberculosis (all forms) and death rates: Registration Area, 1920-1936. Vol. 5, No. 39, July 19, 1938, pp. 211-214.

Deaths from cancer by place of residence: U. S. 1935. Vol. 5, No. 40, July 29, 1938, pp. 215-302.

Number of deaths (exclusive of stillbirths) from each cause, by sex, race, and age: United States, 1936. Vol. 5, No. 41, August 3, 1938, pp. 303-352.

Number of deaths from pneumonia (all forms) and death rates: Registration Area, 1920-1936. Vol. 5, No. 42, August 6, 1938, pp. 353-356.

Number of deaths from diphtheria, and death rates: Registration Area, 1920-1936. Vol. 5, No. 43, August 8, 1938, pp. 357-360.

Number of deaths from typhoid and paratyphoid fever, and death rates: Registration Area, 1920-1936. Vol. 5, No. 44, August 10, 1938, pp. 361-364.

Number of deaths from diarrhea and enteritis (under 2 years) and death rates: Registration Area, 1920-1936. Vol. 5, No. 45, August 12, 1938, pp. 365-368.

Number of deaths (exclusive of stillbirths) from each cause by certain subdivisions of the first year of life: United States, 1936. Vol. 5, No. 46, August 17, 1938, pp. 369-384.

Classification of joint causes of death. A study showing differences resulting from the classification of joint causes of death by 18 nations, undertaken in compliance with the recommendations of the commission for revision of the international list of causes of death. Vol. 5, No. 47, August 30, 1938, pp. 385-470.

State summaries for 1937. Vol. 6, No. 1, June 30, 1938, pp. 1-2.

Vital statistics summary for Nevada: 1937. Vol. 6, No. 2, June 30, 1938, pp. 3-18.

Vital statistics summary for Montana: 1937. Vol. 6, No. 3, July 25, 1938, pp. 19-36.

Vital statistics summary for Connecticut: 1937. Vol. 6, No. 4, August 4, 1938, pp. 37-52.

Vital statistics summary for Indiana: 1937. Vol. 6, No. 5, August 11, 1938, pp. 53-74.

Vital statistics summary for Oklahoma: 1937. Vol. 6. No. 6, August 17, 1938, pp. 75-94.

Vital statistics summary for Utah: 1937. Vol. 6, No. 7, August 22, 1938, pp. 95-110.

Vital statistics summary for Wyoming: 1937. Vol. 6, No. 8, August 26, 1938, pp. 111-126.

Vital statistics summary for Maine: 1937. Vol. 6, No. 9, September 10, 1938, pp. 127-142.

Vital statistics summary for New Jersey: 1937. Vol. 6, No. 10, September 14, 1938, pp. 143-162.

CHIAO, C. M., WARREN S. THOMPSON, and D. T. CHEN. An Experiment in the Registration of Vital Statistics in China. *Oxford, Ohio* (Scripps Foundation for Research in Population Problems), 1938. Pp. [6] + 115. 8⅞ × 6⅞ inches. $1.00 (paper). [Bibliography of 34 titles.]

DOWNES, JEAN. A study of mortality among individuals with active pulmonary tuberculosis. *Milbank Memorial Fund Quarterly*, Vol. 16, pp. 304-317, 1938. [Bibliographic footnotes.]

LEAGUE OF NATIONS. Statistical Year-Book 1937/38. *Geneva* (League of Nations), 1938. Pp. 336. 9⅝ × 7¼ inches.

MACDONALD, ELEANOR J. Accuracy of the cancer death records. *American Journal of Public Health*, Vol. 28, pp. 818-824, 1938. [Bibliography of 2 titles.]

MARTIN, W. J., and E. A. CHEESEMAN. Rural mortality. Its comparative sex incidence. *Biometrika*, Vol. 30, Parts I and II, pp. 57-64, 1938.

MEYER, M. Die Krebskrankenstatistik im Deutschen Reich. XXIV^e *Session de l' Institut International de Statistique, Prague*, 1938. [4 bibliographic footnotes.]

6. *Morbidity and Epidemiology*

DE BERARDINIS, L. Les infirmes dans les recensements de la population. XXIV^e *Session de l'Institut International de Statistique, Prague*, 1938. Pp. (of reprint) 10.

COLLINS, SELWYN D. History and frequency of clinical scarlet fever cases and of injections for artificial immunization among 9,000 families, based on nation-wide periodic canvasses, 1928-31. *Public Health Reports*, Vol. 53, pp. 409-427, 1938. [Bibliography of 34 titles.]

COLLINS, SELWYN D. Frequency of surgical procedures among 9,000 families based on nation-wide periodic canvasses, 1928-31. *Public Health Reports*, Vol. 53, pp. 587-628, 1938. [Bibliography of 19 titles.]

TAYLOR, R. M., M. LISBONNE, L. F. VIDAL, and R. H. HAZEMANN. Investigations on undulant fever in France. *Bulletin of the Health Organization of the League of Nations*, Vol. 7, pp. 503-545, 1938. [Bibliography of 8 titles.]

U. S. PUBLIC HEALTH SERVICE, Division of Public Health Methods, National Institute of Health. The National Health Survey: 1935-36. The Magnitude of the Chronic Disease Problem in the United States. *Preliminary Reports, National Health Survey, Sickness and Medical Care Series, Bulletin* No. 6. *Washington*, 1938. Pp. 19. 10 × 6¾ inches.

U. S. PUBLIC HEALTH SERVICE, Division of Public Health Methods, National Institute of Health. The National Health Survey: 1935-1936. Illness among Employed and Unemployed Workers. *Preliminary Reports, National Health Survey, Sickness and Medical Care Series, Bulletin* No. 7. *Washington*, 1938. Pp. 13. 10 × 7 inches.

7. *Natality, Fecundity, Fertility*

ASHLEY-MONTAGU, M. F. Coming Into Being among the Australian Aborigines. A Study of the Procreative Beliefs of the Native Tribes of Australia. *New York* (E. P. Dutton and Co.), 1938. Pp. xxxv + 362. 9¾ × 6 inches. $5.00. [Bibliography of 7 titles.]

BUREAU OF THE CENSUS. *Vital Statistics—Special Reports, Washington, D. C.* Various numbers as follows:
Provisional birth statistics for 1937. Vol. 5, No. 35, June 22, 1938, pp. 153-160.
Births (exclusive of stillbirths): United States. Vol. 5, No. 38, July 14, 1938, pp. 185-210.

CREW, F. A. E. Notes from a pregnancy diagnosis laboratory (1936). *American Journal of Obstetrics and Gynecology*, Vol. 33, pp. 989-999, 1937.

8. *Birth Control*

LINFIELD, SEYMOUR L. Laws Relating to Birth Control in the United States and Its Territories. *New York* (Birth Control Clinical Research Bureau, 17 West 16th Street), 1938. Pp. 61. 8 × 5⅜ inches. 25 cents (paper).

MATSNER, ERIC M. The Technique of Contraception. An Outline. Fourth Edition. Foreword by Frederick C. Holden. *New York* (National Medical Council on Birth Control, 501 Madison Ave.), 1938. Pp. 50. 9 × 6 inches. (Complimentary copies can be obtained by physicians by writing to the National Medical Council on Birth Control).

9. *Marriage and Divorce*

v. UNGERN-STERNBERG, R. Heiratsalter und Häufigkeit der Ehescheidung. *Zeitschrift für Rassenkunde*, Bd. 7, pp. 297-298, 1938.

III. BEHAVIOR

1. *Racial and Genetic Psychology*

HEIM-LEBRECHT, J. Zur Soziologie des Rassenbewusstseins. *Zeitschrift für Rassenkunde*, Bd. 7, pp. 255-281, 1938. [Bibliography of 1¼ pages.]

HELLPACH, W. Musik and Rasse. *Zeitschrift für Rassenkunde*, Bd. 8, pp. 98-99, 1938. [1 bibliographic footnote.]

KEITER, FRIEDRICH. Volkscharakter und Rassenseele. *Zeitschrift für Rassenkunde*, Bd. 8, pp. 41-53, 1938. [4 bibliographic footnotes.]

MUNN, NORMAN L. Psychological Development. An Introduction to Genetic Psychology. *Boston* (Houghton Mifflin Co.), 1938. Pp. xx + 582. 8½ × 5¾ inches. $3.25. [Bibliography of 35 pages.]

SKINNER, B. F. The Behavior of Organisms. An Experimental Analysis. *New York and London* (D. Appleton-Century Co.), 1938. Pp. ix + 457. 8¾ × 6 inches. $5.00. [Bibliography of 83 titles.]

YERKES, ROBERT M., and JAMES H. ELDER. Concerning reproduction in the chimpanzee. *Yale Journal of Biology and Medicine,* Vol. 10, pp. 41-48, 1937.

2. *Individual Psychology*

CÉLINE, LOUIS-FERDINAND. Death on the Installment Plan. Translated from the French by John H. P. Marks. *Boston* (Little, Brown and Co.), 1938. Pp. 593. 8¼ × 5½ inches. $2.75.

CORNER, GEORGE W. Attaining Manhood. A Doctor Talks to Boys About Sex. *New York* (Harper and Bros.), 1938. Pp. xi + 67. 7¼ × 4¾ inches. $1.25. [List of "Books and Material for Further Study" of 5 titles.]

MONSARRAT, K. W. Human Powers and Their Relations. *London* (Hodder and Stoughton), 1938. Pp. vii + 289. 10 × 6½ inches. 10s. 6d. net. [Bibliographic footnotes.]

MUNN, NORMAN L. A Laboratory Manual in General Experimental Psychology. *New York* (Prentice-Hall, Inc.), 1938. Pp. viii + 286. 11 × 9 inches. $1.90 (paper). [Bibliographic references throughout.]

PYM, T. W. Sex and Sense. *London* (Nicholson and Watson), 1938. Pp. 128. 7¼ × 4⅞ inches. 2s. 6d. net.

REPEAL ASSOCIATES, INC. A Study of the Alcohol Factor in Automobile Accidents. *Washington, D. C.* (Repeal Associates, Inc., Otis Building), 1938. Pp. 31. 9 × 6 inches (paper).

TAYLOR, JAMES G. Popular Psychological Fallacies. *London* (Watts and Co.), 1938. Pp. vii + 275. 8½ × 5½ inches. 7s. 6d. net.

WOOD, F. L. Smoking and Other Habits. Their Effects and Cures. A Medical and Scientific Discussion of the Tobacco, Alcohol, Marijuana and Opium Habits. *Grand Rapids, Mich.* (Zondervan Publishing House), 1938. Pp. 68. 7¾ × 5¼ inches.

3. *Psychiatry*

MALZBERG, BENJAMIN. Outcome of insulin treatment of one thousand patients with dementia praecox. *Psychiatric Quarterly,* Vol. 12, pp. 528-553, 1938. [Bibliography of 5 titles.]

4. *History and Biography*

ADAMS, WALTER S. Biographical memoir of Charles Edward St. John 1857-1935. *National Academy of Sciences, Biographical Memoirs,* Vol. 18, Twelfth Memoir, pp. 285-304, 1937. [Bibliography of 7 pages.]

AMES, JOSEPH S. Biographical memoir of Arthur Gordon Webster 1863-1923. *National Academy of Sciences, Biographical Memoirs,* Vol. 18, Fourteenth Memoir, pp. 337-348, 1937. [Bibliography of 6 pages.]

BILLINGS, JOHN SHAW. Two letters by John Shaw Billings on the history of medicine. Foreword by Sanford V. Larkey. *Bulletin of the Institute of the History of Medicine,* Vol. 6, pp. 394-398, 1938.

BUTLER, CHARLES S. The antiquity of syphilitic aneurism. *The Military Surgeon*, Vol. 82, pp. 485-490, 1938. [Bibliography of 6 titles.]

CANE SUGAR TRADE. James Howell Post 1859-1938, in Memoriam. *New York*, 1938. Pp. [14].

COMPTON, KARL T. Biographical memoir of Augustus Trowbridge 1870-1934. *National Academy of Sciences, Biographical Memoirs*, Vol. 18, Tenth Memoir, pp. 219-244, 1937. [Bibliography of 2 pages.]

CUSHING, HARVEY. Biographical memoir of William Thomas Councilman 1854-1933. *National Academy of Sciences, Biographical Memoirs*, Vol. 18, Seventh Memoir, pp. 157-174, 1937. [Bibliography of 7 pages.]

DARLINGTON, C. D. The early hybridisers and the origins of genetics. *Herbertia*, Vol. 4, pp. 63-69, 1937.

DAVENPORT, CHARLES B. Biographical memoir of George Davidson 1825-1911. *National Academy of Sciences, Biographical Memoirs*, Vol. 18, Ninth Memoir, pp. 189-218, 1937. [Bibliography of 11½ pages.]

FISHER, IRVING. Cournot forty years ago. *Econometrica*, Vol. 6, pp. 198-202, 1938. [Bibliographic footnotes.]

HAMMETT, FREDERICK S. The ideas of the ancient Hindus concerning man. *Isis*, Vol. 28, pp. 57-72, 1938. [Bibliography of 3 titles.]

HERRICK, FRANCIS HOBART. Audubon the Naturalist. A History of His Life and Time. *New York* (D. Appleton-Century Co.), 1938. Pp. vii + 500. 8¾ × 6 inches. $6.00. [Bibliographic footnotes.]

HRDLIČKA, ALEŠ. Biographical memoir of George Sumner Huntington 1861-1927. *National Academy of Sciences, Biographical Memoirs*, Vol. 18, Eleventh Memoir, pp. 245-284, 1937. [Bibliography of 7½ pages.]

INDIAN RESEARCH FUND ASSOCIATION. Proceedings of the Fifteenth Research Workers' Conference, held at New Delhi from 29th November to 4th December, 1937. Appendix to the Technical Report of the Scientific Advisory Board for the year 1937. *New Delhi*, 1938. Pp. 103. 9¾ × 6¼ inches (paper).

INDIAN RESEARCH FUND ASSOCIATION. Report of the Scientific Advisory Board for the Year 1st January to 31st December, 1937. *New Delhi, India* (Indian Research Fund Association), 1938. Pp. v + 160. 9¾ × 6¼ inches. One rupee (paper).

IRWIN, J. O. Recent advances in mathematical statistics, 1937. Bibliography (1935-37). *Journal of the Royal Statistical Society*, Vol. 101, Part II, pp. 394-433, 1938.

JACKSON, CHEVALIER. The Life of Chevalier Jackson. An Autobiography. *New York* (The Macmillan Co.), 1938. Pp. x + 229 + 64 plates. 8⅛ × 5¼ inches. $3.50.

KANSAS STATE COLLEGE. Summary of Twenty-Five Years of Work in the Departments of Entomology and Zoology at Kansas State College. *Kansas State College Bulletin*, Vol. 21, No. 9. *Manhattan* (Kansas State College), 1937. Pp. 5.

KLAAUW, C. J. VAN DER, J. A. J. BARGE, and AD. MEYER. Bibliographia Biotheoretica quam ediderunt qui praesunt Fundationi cui nomen est "Prof. Dr. Jan van der Hoeven-Stichting voor theoretische biologie van dier en mensch,

verbonden aan de Rijksuniversiteit te Leiden". Serie C. Titulos Librorum, etc. Annorum MCMXXV, MCMXXVI, MCMXXVII, MCMXXVIII, MCMXXIX, collected and edited by C. J. van der Klaauw, J. A. J. Barge and Ad. Meyer. *Leiden* (E. J. Brill), 1938. Pp. xi + 236. 9⅞ × 6½ inches. 11 guilders.

KNOPF, ADOLPH. Biographical memoir of Edward Salisbury Dana 1849-1935. *National Academy of Sciences, Biographical Memoirs,* Vol. 18, Fifteenth Memoir, pp. 349-366, 1937. [Bibliography of 6½ pages.]

KRÜGER, EKKEMAR H. C.N.S. Sonnini über die Anthropologie seiner Zeit. *Zeitschrift für Rassenkunde,* Bd. 8, pp. 100-101, 1938. [Bibliographic footnotes.]

LARKEY, SANFORD V. John Shaw Billings and the history of medicine. *Bulletin of the Institute of the History of Medicine,* Vol. 6, pp. 360-376, 1938. [Bibliographic footnotes.]

THE JOHN AND MARY R. MARKLE FOUNDATION. Annual Report 1937. *14 Wall Street, New York,* 1938. Pp. 18.

MILLER, GENEVIEVE. Unpublished autographs in the Welch Medical Library. 3. An autograph of Johannes Tackius (1617-1675). *Bulletin of the Institute of the History of Medicine,* Vol. 5, pp. 933-935, 1937.

MILLER, GENEVIEVE, and SANFORD V. LARKEY. An exhibit of the works of Claude Bernard. *Bulletin of the Institute of the History of Medicine,* Vol. 6, pp. 649-668, 1938.

NEQUATEWA, EDMUND. Dr. Fewkes and Masauwu. The birth of a legend. *Museum Notes* (Museum of Northern Arizona), Vol. 11, pp. 25-27, 1938.

O'CONNOR, BASIL. The National Foundation for Infantile Paralysis. General Statement of Plans and Appointment of Committees. *New York,* 1938. Pp. 5.

PERRY, RALPH B. In the Spirit of William James. *New Haven* (Yale University Press), 1938. Pp. xii + 211. 8 × 5¼ inches. $2.00. [Bibliographic footnotes.]

ROCKEFELLER FOUNDATION. Annual Report 1937. *49 West 49th St., New York,* 1938. Pp. 506. 8¾ × 5¾ inches.

SAVA, GEORGE. The Healing Knife. A Surgeon's Destiny. *New York* (Harcourt, Brace and Co.), 1938. Pp. x + 310. 8 × 5½ inches. $2.50.

SCHLESINGER, FRANK. Biographical memoir of William Lewis Elkin 1855-1933. *National Academy of Sciences, Biographical Memoirs,* Vol. 18, Eighth Memoir, pp. 175-188, 1937. [Bibliography of 2 pages.]

SCOTT, JOHN P. Democracy and the story. *Educational Forum,* January, 1938, pp. 165-171.

SIGERIST, HENRY E. Why academies were founded. *Transactions of the College of Physicians of Philadelphia,* Vol. 4, pp. 83-88, 1937.

SIGERIST, HENRY E. The development of medicine and its trends in the United States 1636-1936. *New England Journal of Medicine,* Vol. 218, pp. 325-328, 1938.

SIGERIST, HENRY E. Medico-historical activities in the United States. *Bulletin of the Institute of the History of Medicine,* Vol. 6, pp. 669-676, 1938.

SIGERIST, HENRY E. Report of the activities of the Institute of the History of Medicine of the Johns Hopkins University during the academic year 1937-

1938. *Bulletin of the Institute of the History of Medicine,* Vol. 6, pp. 858-881, 1938.

STEJNEGER, LEONHARD. Biographical memoir of Carl H. Eigenmann 1863-1927. *National Academy of Sciences, Biographical Memoirs,* Vol. 18, Thirteenth Memoir, pp. 305-336, 1937. [Bibliography of 12½ pages.]

STEVENS, H. R. A study of notable Ohioans. *Ohio State Archaeological and Historical Quarterly,* Vol. 47, pp. 159-167, 1938. [5 bibliographic footnotes.]

TORNAY, STEPHEN C. Ockham. Studies and Selections. *LaSalle, Ill.* (Open Court Publishing Co.), 1938. Pp. viii + 207. 7¾ × 5⅜ inches. $1.75. [Writings of William of Ockham of 8 titles and bibliographic footnotes throughout.]

WETHERED, H. N. The Mind of the Ancient World. A Consideration of Pliny's Natural History. *London and New York* (Longmans, Green and Co.), 1937. Pp. xv + 302. 8½ × 5¾ inches. $4.00.

THE WISTAR INSTITUTE, SCIENTIFIC ADVISORY COMMITTEE. Memoir of Milton J. Greenman 1866-1937. *Printed and distributed by order of the Board of Managers of The Wistar Institute.* Pp. 10.

WOODWARD, ARTHUR. A Brief History of Navajo Silversmithing. *Museum of Northern Arizona* Bulletin 14. *Flagstaff, Ariz.* (Northern Arizona Society of Science and Art), 1938. Pp. iii + 78. 8¼ × 5¼ inches. [Bibliography of 7 pages.]

YULE, G. U. Notes of Karl Pearson's lectures on the theory of statistics, 1884-96. *Biometrika,* Vol. 30, Parts I and II, pp. 198-203, 1938. [Bibliography of 6 titles.]

5. *Sociology, Law, Politics and Religion*

ADAMS, G. P., W. R. DENNES, J. LOEWENBERG, D. S. MACKAY, P. MARHENKE, S. C. PEPPER, and E. W. STRONG. Knowledge and Society. A Philosophical Approach to Modern Civilization. *New York and London* (D. Appleton-Century Co.), 1938. Pp. xiii + 417. 8¾ × 6 inches. $2.75. [Bibliographic footnotes.]

ALLEE, W. C. The Social Life of Animals. *New York* (W. W. Norton and Co.), 1938. Pp. 293. 8 × 5½ inches. $3.00. [Bibliography of 11 titles.]

CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE. The proposed Universal Peace Commission of 1910. *International Conciliation,* No. 342, pp. 315-334, 1938.

HUDSON, ALFRED E. Kazak Social Structure. *Yale University Publications in Anthropology* Number 20. *New Haven* (Yale University Press); *London* (Oxford University Press), 1938. Pp. 109. 9¾ × 7 inches. $1.50. [Bibliography of 3½ pages.]

HULL, CORDELL. The spirit of international law. *International Conciliation,* No. 342. Pp. 297-310, 1938.

JAPANESE CHAMBER OF COMMERCE OF NEW YORK. The Sino-Japanese Crisis 1937. First comprehensive, authentic, factual statement, with official American and Japanese documents. *New York* (Japanese Chamber of Commerce, 500 Fifth Avenue), [1938]. Pp. 92. 9 × 5¾ inches (paper).

MILLER, NEVILLE. The place of radio in American life. *Address delivered at the Commencement Exercises of Peabody College, Nashville, Tenn.*, August 19, 1938. Pp. (of reprint) 10.

NEWSTETTER, WILBER I., MARC J. FELDSTEIN, and THEODORE M. NEWCOMB. Group Adjustment. A Study in Experimental Sociology. *Cleveland, Ohio* (School of Applied Social Sciences, Western Reserve University), 1938. Pp. xv + 154. 9 × 5¾ inches. $2.00. [Bibliographic footnotes.]

SAYRE, FRANCIS B. American foreign policy. *International Conciliation*, No. 342, pp. 311-314, 1938.

STEINWALLNER, B. Faschistisches Rassenrecht. *Zeitschrift für Rassenkunde*, Bd. 7, p. 299, 1938.

U. S. DEPARTMENT OF LABOR, Children's Bureau. Child-Welfare Legislation 1937. *Bureau Publication* No. 236. *Washington* (Government Printing Office), 1938. Pp. iii + 91. 9¼ × 6 inches. 10 cents (paper).

U. S. DEPARTMENT OF LABOR, Children's Bureau. A Historical Summary of State Services for Children in Alabama. *Bureau Publication* No. 239, Part 3. *Washington* (Government Printing Office), 1938. Pp. 34. 9¼ × 6 inches.

VANVALKENBURGH, RICHARD F. Navajo Common Law III. Etiquette—Hospitality—Justice. *Museum Notes* (Museum of Northern Arizona), Vol. 10, No. 12, pp. 39-45, 1938.

6. *Economics*

BRATT, ELMER C. The Divisibility of Time Series. *Lehigh University Publications*, Vol. 12, No. 7. *The Institute of Research. Circular* No. 141. *Studies in the Humanities* No. 20. *Bethlehem, Pa.* (Lehigh University), 1938. Reprinted from *Review of Economic Studies*. Pp. 79-92. 9 × 5¾ inches. 10 cents (paper).

BUREAU OF LABOR STATISTICS. The Fair Labor Standards Act of 1938. *Labor Information Bulletin, Bureau of Labor Statistics, U. S. Department of Labor*, July, 1938. Pp. (of reprint) 5.

COFFEE, JOHN M. What private monopoly of oil costs. *Congressional Record, Seventy-fifth Congress, First Session*, 1938. Pp. (of reprint) 4.

DORE, VALENTINO. Le recensement agricole mondial de 1940. XXIV[e] *Session de l'Institut International de Statistique, Prague*, 1938. Pp. (of reprint) 5.

GODSIL, H. C. The High Seas Tuna Fishery of California. *Bureau of Marine Fisheries, Fish Bulletin* No. 51. *Sacramento* (Bureau of Marine Fisheries), 1938. Pp. 41. 9 × 5 inches (paper). [Bibliography of 13 titles.]

HUBER, M., and H. ULMER. La statistique agricole dans certains pays où elle présente des difficultés particulières. XXIV[e] *Session de l'Institut International de Statistique, Prague*, 1938. Pp. (of reprint) 8.

LARSON, OLAF F. Rural Households and Dependency. A Comparative Study of Composition and Behavior of Relief and Non-Relief Households in Three Colorado Counties. *Fort Collins, Colo.* (Colorado State College, Colorado Experiment Station) and *Washington, D. C.* (Rural Section, Division of Social Research, Works Progress Administration). Bulletin 444, May, 1938. Pp. 48. 9 × 6 inches.

MOLINARI, A. Deuxième rapport sur les statistiques de la distribution. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 38.

NEW YORK STATE TAX COMMISSION. Rates of assessment of real property for the several cities, towns and villages of the state as finally fixed and determined by the State Tax Commission for the year 1938. *New York State Tax Bulletin,* Vol. 23, No. 1. *Albany, N. Y.,* 1938. Pp. 17. 9 × 5¾ inches.

NEW YORK STATE TAX COMMISSION. Concerning milk publicity tax law of 1934 and amendments of 1935, 1936, 1937 and 1938. *New York State Tax Bulletin,* Vol. 23, No. 3. *Albany, N. Y.,* 1938. Pp. 23. 9 × 5¾ inches.

NEW YORK STATE TAX COMMISSION. The tax law as it relates to the assessment and taxation of real property. (Articles 1-8). *New York State Tax Bulletin,* Vol. 23, No. 4. *Albany, N. Y.,* 1938. Pp. 108. 9 × 5¾ inches.

NEW YORK STATE TAX COMMISSION. The tax law as it relates to the duties of assessors in assessment of real property for taxation. (Articles 1-2). *New York State Tax Bulletin.* Vol. 23, No. 5. *Albany, N. Y.,* 1938. Pp. 32. 9 × 5¾ inches.

NEW YORK STATE TAX COMMISSION. The village law relative to assessment of real property, collection of taxes thereon, and sale of land or liens for unpaid taxes. (Applicable to villages operating under the General Village Law). (Article 5—finances). *New York State Tax Bulletin,* Vol. 23, No. 6. *Albany, N. Y.,* 1938. Pp. 41. 9 × 5¾ inches.

NILES, HENRY E., and M. C. H. NILES. Assistance in coordination. *Personnel,* Vol. 15, pp. 1-15, 1938.

PRENANT, MARCEL. Biology and Marxism. *New York* (International Publishers), 1938. Pp. xxiii + 223. 8½ × 5½ inches. $2.50. [Bibliographic footnotes and bibliography of 4½ pages.]

U. S. PUBLIC HEALTH SERVICE, Division of Public Health Methods, National Institute of Health. The National Health Survey: 1935-1936. The Relief and Income Status of the Urban Population of the United States, 1935. *Preliminary Reports, National Health Survey, Population Series, Bulletin* No. C. *Washington,* 1938. Pp. xv + 29 + 6 charts. 11 × 8½ inches.

7. *Education*

COMMISSION OF SECONDARY SCHOOL CURRICULUM, PROGRESSIVE EDUCATION ASSOCIATION. Science in General Education. Suggestions for Science Teachers in Secondary Schools and in the Lower Division of Colleges. Report of the Committee on the Function of Science in General Education. *New York* (D. Appleton-Century Co.), 1937. Pp. xiii + 591. 8½ × 5½ inches. [Bibliographies and/or bibliographic footnotes to some of the chapters.]

SCHWIDETZKY, L. Eine neue Rassenwandkarte der Welt. *Zeitschrift für Rassenkunde,* Bd. 8, pp. 101-106, 1938. [Bibliographic footnotes.]

8. *Ethnology, Cultural Anthropology, Travel and Exploration*

ARMSTRONG, NEVILL A. D. After Big Game in the Upper Yukon. *London* (John Long), 1938. Pp. 287 + 16 plates. 9 × 6 inches. 18s. net.

BUNZENDAHL, OTTO. Der Australien-Forscher Dr. Erhard Eylmann und seine Sammlung im Deutschen Kolonial- und Übersee-Museum zu Bremen. *Veröffentlichungen aus dem Deutschen Kolonial- und Uebersee-Museum in Bremen*, Bd. 2, pp. 33-80, 1938. [Bibliographic footnotes.]

CHISHOLD, WM. H. Vivid Experiences in Korea. Foreword by Howard A. Kelly. *Chicago* (Bible Institute Colportage Assn.), 1938. Pp. 136. 7¼ × 5 inches. $1.00.

COLTON, MARY-RUSSELL F. The arts and crafts of Hopi Indians. Their historic background, processes and methods of manufacture and the work of the Museum for the maintenance of Hopi art. *Museum Notes* (Museum of Northern Arizona), Vol. 11, pp. 1-24, 1938. [Bibliography of 20 titles.]

HILL, W. W. The Agricultural and Hunting Methods of the Navaho Indians. *Yale University Publications in Anthropology* Number 18. *New Haven* (Yale University Press); *London* (Oxford University Press), 1938. Pp. 194 + 4 plates. 9¾ × 6¾ inches. $2.50 (paper). [Bibliography of 74 titles.]

LA BARRE, WESTON. The Peyote Cult. *Yale University Publications in Anthropology* Number 19. *New Haven* (Yale University Press); *London* (Oxford University Press), 1938. Pp. 188 + 2 plates. 9¾ × 7 inches. $2.50 (paper). [Bibliography of 13½ pages.]

NORTH, F. J. Finland in Summer. *Cambridge* (W. Heffer and Sons), 1938. Pp. xv + 233 + 76 plates. 8½ × 5½ inches. 10s. 6d. net. [List of "Some Books About Finland" of 22 titles.]

PARK, WILLARD Z. Shamanism in Western North America. A Study in Cultural Relationships. *Evanston and Chicago* (Northwestern University), 1938. Pp. viii + 166. 9 × 6 inches. $2.25. [Bibliography of 5 pages.]

STIRLING, M. W. Historical and Ethnographical Material on the Jivaro Indians. *Smithsonian Institution, Bureau of American Ethnology, Bulletin* 117. *Washington, D. C.* (U. S. Government Printing Office), 1938. Pp. xi + 148 + 37 plates + 1 folding map. 9⅛ × 5¾ inches. 35 cents (paper). [Bibliography of 7½ pages.]

TICHY, MARJORIE F. The Kivas of Paako and Kuaua. *New Mexico Anthropologist*, Vol. 2, pp. 71-80, 1938. [Bibliographic footnotes.]

VAN VALKENBURGH, RICHARD F., and SCOTTY BEGAY. Sacred places and shrines of the Navajo. Part I. The sacred mountains. *Museum Notes* (Museum of Northern Arizona), Vol. 11, pp. 29-33, 1938.

WARD, F. KINGDON. Plant Hunter's Paradise. *New York* (The Macmillan Co.), 1938. Pp. 347. 7¾ × 5¼ inches. $3.50.

WILLIAMS, JOSEPH J., *S.J.* Africa's God. IX—South Africa. *Anthropological Series of the Boston College Graduate School*, Vol. III, No. 2. *Chestnut Hill, Mass.* (Boston College Press), 1938. Pp. 54. 9¾ × 6⅛ inches. $1.00 (paper). [Bibliography of 4½ pages.]

IV. SOMATOLOGY AND CONSTITUTION

1. *Anatomy*

APPLETON, ARTHUR B., WILLIAM J. HAMILTON, and IVAN C. C. TCHAPEROFF. Surface and Radiological Anatomy. For Students and General Practitioners.

Baltimore (William Wood and Co.), 1938. Pp. xi + 311. 9½ × 6½ inches. $5.50.

BENSLEY, R. R., and S. H. BENSLEY. Handbook of Histological and Cytological Technique. *Chicago* (University of Chicago Press), 1938. Pp. viii + 167. 11 × 8⅝ inches. $2.00. [Bibliographic footnotes.]

CLAOUÉ, CH. Oreille Interne. Étude anatomo-pathologique et clinique. Technique histologique et expérimentale. 2e Edition. *Paris* (Éditions N. Maloine), 1938. Pp. x + 227. 10 × 6½ inches. 30 francs (paper). [Bibliography of 4 pages.]

COWDRY, E. V. A Textbook of Histology. Functional Significance of Cells and Inter-cellular Substances. Second Edition, Thoroughly Revised. *Philadelphia* (Lea and Febiger), 1938. Pp. 600. 10¼ × 6⅝ inches. $7.00. [Bibliography of 23 pages.]

GOODALL, ALEXANDER. Aids to Histology. Fourth Edition. *Baltimore* (William Wood and Co.), 1938. Pp. viii + 151. 6¼ × 4 inches. $1.25.

GRAY, H. Sacro-iliac joint pain. I. The finer anatomy. *International Clinics*, Vol. 2, Ser. 48, pp. 53-63 + 7 plates, 1938.

GRAY, H. Sacro-iliac joint pain: II. Mobility and axes of rotation. *International Clinics*, Vol. 2, Ser. 48, pp. 65-76, 1938.

HUNTER, RICHARD H. Aids to Embryology. Third Edition. *Baltimore* (William Wood and Co.), 1938. Pp. vii + 178. 6¼ × 3⅞ inches. $1.25.

MAXIMOW, ALEXANDER A., and WILLIAM BLOOM. A Textbook of Histology. Third Edition, Completely Revised. *Philadelphia and London* (W. B. Saunders Co.), 1938. Pp. xv + 668. 9¾ × 6¼ inches. $7.00. [References at the end of each chapter.]

MESSER, HAROLD M. An Introduction to Vertebrate Anatomy. *New York* (The Macmillan Co.), 1938. Pp. xvi + 406. 8½ × 5¾ inches. $3.50. [Bibliography of 2½ pages.]

MING-TZU, P'AN. Origin of deep and circumflex femoral group of arteries in the Chinese. *American Journal of Physical Anthropology*, Vol. 22, pp. 417-424, 1937. [Bibliography of 5 titles.]

NOVIKOFF, M. Sur la question des rapports entre la forme et la fonction des organismes. *Bulletin de l'Association Russe pour les Recherches Scientifiques à Prague*, Vol. 6 (XI). *Section des sciences naturelles et matématiques* No. 37, pp. 87-108, 1937. [Bibliography of 31 titles.]

NOWIKOFF, M. Das Studium der Homomorphien als eine wissenschaftliche Methode. *Biologia Generalis*, Bd. 14, pp. 85-110, 1938. [Bibliographic footnotes.]

SAYLES, LEONARD P. Manual for Comparative Anatomy. *New York* (The Macmillan Co.), 1938. Pp. xi + 214. 10 × 7½ inches. $1.60.

TE-WEI, CHANG. Anomalous pyramidal decussation in the Chinese. *Chinese Medical Journal*, Vol. 53, pp. 53-56, 1938. [Bibliography of 6 titles.]

WALKER, A. EARL. The Primate Thalamus. *Chicago* (University of Chicago Press), 1938. Pp. xxiii + 321. 9 × 6 inches. $3.00. [Bibliography at the end of each chapter.]

ZEIGER, K. Physikochemische Grundlagen der histologischen Methodik. *Dresden and Leipzig* (Verlag von Theodor Steinkopff), 1938. Pp. xi + 202. 8¾ ×

6 inches. RM. 10.50 (paper); RM. 11.25 (cloth). [Bibliographic footnotes throughout.]

2. *Physical Anthropology and Anthropometry*

AUERHAN, J. De la relation entre le milieu géographique et la taille des conscrits. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 8.

CATTERJEE, A. The Bengalee school-boy—his physical development. *Zeitschrift für Rassenkunde,* Bd. 8, pp. 53-61, 1938.

COUNT, EARL W. The "Australoid" in California. *Zeitschrift für Rassenkunde,* Bd. 8, pp. 62-95, 1938. [Bibliography of 7 titles.]

DREYER, T. F., A. J. D. MEIRING, and A. C. HOFFMAN. A comparison of the Boskop with other abnormal skull-forms from South Africa. *Zeitschrift für Rassenkunde,* Bd. 7, pp. 289-296, 1938. [Bibliography of 10 titles.]

FRETS, G. P. The relation of head-length and head-index of Johannsen and the spurious correlation of Pearson. *Proceedings Koninklijke Akademie van Wetenschappen te Amsterdam,* Vol. 40, pp. 454-461, 1937. [Bibliography of 24 titles.]

LE RICHE, HARDING. The A. C. H. index as applied to boys and girls in selected Pretoria schools. *South African Journal of Medical Science,* Vol. 3, pp. 60-62, 1938. [Bibliography of 9 titles.]

LI, P. H., F. T. CHU, and P. H. STEVENSON. Measuring infants and children. Choice of measurements, equipments and technique. *Chinese Medical Journal,* Vol. 52, pp. 549-570, 1937. [Bibliography of 11 titles.]

LOTH, E. Über den Sinus frontalis des Neanderthalers. *Zeitschrift für Rassenkunde,* Bd. 8, pp. 96-98, 1938.

LUNDMAN, BERTIL J. Neue Karten der Höhenverhältnisse des Schädels. *Zeitschrift für Rassenkunde,* Bd. 8, pp. 26-32, 1938. [1 bibliographic footnote.]

MALEŠ, B. Die Rassentypen bei den Serben und Kroaten. *Zeitschrift für Rassenkunde,* Bd. 7, pp. 234-251, 1938. [Bibliography of 46 titles.]

NYÈSSEN, D. J. H. Sur l'anthropographie de l'Arc de la Sonde. *Zeitschrift für Rassenkunde,* Bd. 7, pp. 302-303, 1938.

PEDERSEN, P. O. Investigations into dental conditions of about 3,000 ancient and modern Greenlanders. A preliminary report. *The Dental Record* [no date, but 1937 or 1938]. Pp. (of reprint) 8. [2 bibliographic footnotes.]

ROBB, ROBERT, and JOHN CLARKE. Growth of bone shafts in the human fetus. *Proceedings of the Society for Experimental Biology and Medicine,* Vol. 31, pp. 634-636, 1934. [4 bibliographic footnotes.]

STEVENSON, PAUL H. Height-weight-surface formula for the estimation of surface area in Chinese subjects. *Chinese Journal of Physiology,* Vol. 12, pp. 327-330, 1937. [Bibliography of 4 titles.]

THOMPSON, HELEN. Body proportions in the growing infant. *Growth,* Vol. 2, pp. 1-12, 1938. [Bibliography of 15 titles.]

WHEELER, RALPH E. Results of distance vision tests in a rural population. *Milbank Memorial Fund Quarterly,* Vol. 16, pp. 294-303, 1938.

3. *Constitution*

BEHN, S., and C. FERVERS. Die Suggestion der Maschine und der eckig-sehnige Konstitutionstypus. *Zeitschrift für Rassenkunde*, Bd. 7, pp. 217-234, 1938.

DUBLIN, LOUIS I., and HERBERT H. MARKS. The Build of Women and its Relation to Their Mortality. A Preliminary Report. Read at the Forty-eighth Annual Meeting of the Association of Life Insurance Medical Directors of America, October 28-29, 1937. *New York* (The Association of Life Insurance Medical Directors of America), 1938. Pp. 32. 9 × 6 inches.

GRAY, H. Body-build in Illinois convicts with special reference to age. *Journal of Criminal Law and Criminology*, Vol. 25, pp. 554-575, 1934. [Bibliography of 8 titles.]

V. PHYSIOLOGY AND BIOCHEMISTRY

1. *Physiology*

CRANDALL, LATHAN A., JR. An Introduction to Human Physiology. Second Edition, Revised. *Philadelphia and London* (W. B. Saunders Co.), 1938. Pp. 356. 7¾ × 5⅜ inches. $2.00. [List of "Textbooks of Physiology and General Reference" of 4 pages.]

GENNA, G. Grundumsatz und Lebensablauf der Rassen. *Zeitschrift für Rassenkunde*, Bd. 7, pp. 209-217, 1938. [Bibliography of 10 titles.]

GRAY, H., and FREDERICK J. DALY. Athletic performance as a function of growth: Speed in sprinting. *Journal of Pediatrics*, Vol. 6. p. 14 ff., 1935. [Bibliography of 11 titles.]

HALLIBURTON, W. D., and R. J. S. MCDOWALL. Handbook of Physiology and Biochemistry. Thirty-fifth edition. *Philadelphia* (P. Blakiston's Sons and Co.), 1938. Pp. xi + 973. 8½ × 6 inches. $5.50.

HAMMETT, FREDERICK S. Nutrition vs. growth. *Science*, Vol. 86, pp. 560-561, 1937. [1 bibliographic footnote.]

HARDING, T. SWANN. Are we elephants or men? *American Journal of Pharmacy*, March, 1938, pp. 121-127.

HENDERSON, YANDELL. Adventures in Respiration. Modes of Asphyxiation and Methods of Resuscitation. *Baltimore* (Williams and Wilkins Co.), 1938. Pp. xi + 316. 8⅛ × 5½ inches. $3.00. [Bibliography of 20 pages.]

HESS, W. R. Das Zwischenhirn und die Regulation von Kreislauf und Atmung. *Beiträge zur Physiologie des Hirnstammes.. II. Teil. Leipzig* (Georg Thieme Verlag), 1938. Pp. [8] + 127. 12¼ × 8¾ inches. RM. 26. (25 percent discount outside of Germany) (paper). [Bibliography of 6½ pages.]

HOUSEHOLDER, A. S., and E. AMELOTTI. Some aspects of Rashevsky's theory of delayed reflexes. *Psychometrika*, Vol. 2, pp. 255-262, 1937. [Bibliography of 2 titles.]

JENKINS, WILLIAM L. Studies in Thermal Sensitivity. *Lehigh University Publications*, Vol. 12, No. 5. *The Institute of Research. Circular* No. 139. *Studies in Science and Technology* No. 117. *Bethlehem, Pa.* (Lehigh University), 1938. Reprinted from *Journal of Experimental Psychology*. Vol. 21, pp. 670-677; Vol. 22, pp. 84-89 and 164-185. 9 × 5¾ inches. 10 cents (paper).

LANDAHL, HERBERT D. Mathematical biophysics of cell respiration. *Growth*, Vol. 1, pp. 263-277, 1937. [Bibliography of 9 titles.]

LANDAUER, WALTER. Loss of body heat and disease. *American Journal of the Medical Sciences*, Vol. 194, pp. 667-674, 1937. [Bibliography of 20 titles.]

LIPSCHÜTZ, A. Androgenic endocrine activity in the female mammal. *Nature*, Vol. 140, p. 892, 1937. [Bibliography of 8 titles.]

LIPSCHÜTZ, A. Hyperplasie expérimentale de l'endomètre avec prolifération atypique et tumorale de l'épithèle utérin après des interventions ovariennes. *Gynécologie et Obstétrique*, T. 36, pp. 407-426; 481-498; T. 37, pp. 17-43, 1937-1938. [Bibliography of 2½ pages.]

MITCHELL, PHILIP H. A Textbook of General Physiology for Colleges. Third Edition. *New York and London* (McGraw-Hill Book Co.), 1938. Pp. xviii + 853. 9 × 6 inches. $6.00. [Bibliographies at the end of each chapter.]

MITCHELL, PHILIP H., and IVON R. TAYLOR. Laboratory Manual of General Physiology. First Edition. *New York and London* (McGraw-Hill Book Co.), 1938. Pp. xv + 142. 9 × 6 inches. $1.50.

RASHEVSKY, N. Physico-mathematical aspects of excitation and conduction in nerves. *Cold Spring Harbor Symposia on Quantitative Biology*, Vol. 4, pp. 90-97, 1936.

RASHEVSKY, N. Mathematical biophysics of conditioning. *Psychometrika*, Vol. 2, pp. 199-209, 1937. [3 bibliographic footnotes.]

RASHEVSKY, N. Mathematical theory of the transmission of excitation from one tissue to another. *Acta Biotheoretica*, Vol. 3, Pars 2, pp. 81-86, 1937. [Bibliography of 5 titles.]

RASHEVSKY, NICOLAS. Mathematical Biophysics. Physicomathematical Foundations of Biology. *Chicago* (University of Chicago Press), 1938. Pp. xvii + 340. 9½ × 6½ inches. $4.00. [Bibliographic footnotes.]

REINER, JOHN M. Diffusion and biological membrane permeability. I. *Growth*, Vol. 1, pp. 313-327, 1937. [Bibliography of 26 titles.]

ROGERS, CHARLES G. Textbook of Comparative Physiology. Second Edition. *New York and London* (McGraw-Hill Book Co.), 1938. Pp. xviii + 715. 9 × 6 inches. $5.50.

STROUD, JAMES B. Introduction to General Psychology. *New York* (Prentice-Hall, Inc.), 1938. Pp. xv + 681. 8 × 5⅝ inches. $3.25. ["Selected References" at the end of each chapter and bibliographic footnotes.]

TIMME, WALTER, ANGUS M. FRANTZ, and CLARENCE C. HARE [Editors]. The Pituitary Gland. An Investigation of the Most Recent Advances. *Association for Research in Nervous and Mental Disease. Vol. XVII of a Series of Research Publications. The Proceedings of the Association, New York, December 28th and 29th, 1936. Baltimore* (Williams and Wilkins Co.), 1938. Pp. xxiv + 764. 9 × 6 inches. $10.00. [Bibliography at the end of each chapter.]

WEINBERG, ALVIN M. A case of biological periodicity. *Growth*, Vol. 2, pp. 81-92, 1938. [Bibliography of 5 titles.]

YOUNG, GAYLORD. Concentration fields and mechanical forces in metabolizing systems. *Physics*, Vol. 7, pp. 380-386, 1936. [7 bibliographic footnotes.]

YOUNG, GAYLORD. Note on excitation theories. *Psychometrika*, Vol. 2, pp. 103-106, 1937. [3 bibliographic footnotes.]

YOUNG, GAYLORD. Action current variation along nerves in series. *Acta Biotheoretica*, Vol. 3, Pars 2, pp. 149-152, 1937. [Bibliography of 2 titles.]

YOUNG, G., and J. M. REINER. Mechanical forces and torque on an ellipsoid in diffusion fields in connection with the problem of orientation of colloidal micellae in biological systems. *Growth*, Vol. 1, pp. 251-261, 1937. [Bibliography of 9 titles.]

2. *Senescence, Senility and Longevity*

ABDERHALDEN, EMIL, and M. BÜRGER [Editors]. Zeitschrift für Altersforschung. Organ für Erforschung der Physiologie und Pathologie der Erscheinungen des Alterns, Bd. 1. *Dresden and Leipzig* (Verlag von Theodor Steinkopff), 1938. Pp. 88. 9½ × 6⅝ inches. Annual subscription RM. 30.

ALESTRA, LEONARDO. La pressione venosa nell'età senile. *Cuore e Circolazione*, Anno 21, N.S., 1937. Pp. (of reprint) 11. [Bibliography of 14 titles.]

ALESTRA, LEONARDO. Indagini clinico-statistiche nei longevi. *Bullettino delle Scienze Mediche*, Anno 109, Fasc. 4, 1937. Pp. (of reprint) 14. [Bibliography of 2 pages.]

ALESTRA, LEONARDO. Rilievi biometrici su due centurie di vecchi. *Endocrinologia e Patologia Costituzionale*, Vol. 12, pp. 532-554, 1937. [Bibliography of 13 titles.]

BERGEL, ARTUR. Über das physikalisch-chemische Verhalten pleuraler und peritonealer Transsudate und Exsudate bei Greisen. Zur Differentialdiagnose der exsudativen Pleuritis und Peritonitis im Greisenalter. *Zeitschrift für Altersforschung*, Bd. 1, pp. 27-37, 1938. [Bibliography of 11 titles.]

BÜRGER, M. Die Bedeutung des Alternsvorgangs für die Klinik. *Zeitschrift für Altersforschung*, Bd. 1, pp. 3-8, 1938.

GRAUHAN, M. Alter und Resektion des Magenkrebses. *Zeitschrift für Altersforschung*, Bd. 1, pp. 49-56, 1938.

GUMBEL, E. J. Théorie des plus grandes valeurs. Applications à la radioactivité, à la durée de la vie humaine et aux inondations. *Bulletin Bi-Mensuel Société Français de Physique*, No. 417, p. 60, 1938.

HÖLZER, HEINZ. Untersuchungen über die Abhängigkeit der Senkungsgeschwindigkeit der roten Blutkörperchen beim gesunden Menschen vom Lebensalter. *Zeitschrift für Altersforschung*, Bd. 1, pp. 9-22, 1938. [Bibliography of 30 titles.]

LIESEGANG, RAPHAEL Ed. Altern des Nichtlebenden. Eine Einführung. *Zeitschrift für Altersforschung*, Bd. 1, pp. 23-26, 1938.

MYSLIVEC, VÁCLAV. Dědičnost délky Lidského Života. [On the Inheritance of the Duration of Life.] *Praha* (Nákladem Svaze čsl. Pojišťoven), 1938. Pp. 40. 9½ × 6¼ inches (paper). [Bibliography of 1½ pages.] [In Czechish with German, French and English summaries.]

MYSLIVEC, VÁCLAV. K Lexisově teorii normálné délky lidského života. *Pojistného Obzoru*, Vol. 191, 1938. Pp. (of reprint) 10. [Bibliography of 33 titles.]

PEARL, RAYMOND. The search for longevity. *Scientific Monthly*, Vol. 46, pp. 462-483, 1938. [10 bibliographic footnotes.]

RIESMAN, DAVID. High Blood Pressure and Longevity and Other Essays Selected from the Published Writings of David Riesman. *Philadelphia* (John C. Winston Co.), 1938. Pp. xii + 726. 9 × 6 inches. (Not for sale). [Bibliography of David Riesman of 10½ pages, also bibliographic references at the end of some essays.]

SCHLOMKA, G. Über Alternsänderungen der Herzfunktion. *Zeitschrift für Altersforschung,* Bd. 1, pp. 38-48, 1938. [Bibliography of 17 titles.]

UEBERMUTH, H. Über Wesen und Ursachen frühzeitiger Altersveränderungen der Menschlichen Zwischenwirbelscheiben. *Zeitschrift für Altersforschung,* Bd. 1, pp. 57-60 + 2 plates, 1938.

3. *Biochemistry*

ANDERSON, C. G. An Introduction to Bacteriological Chemistry. *Baltimore* (William Wood and Co.), 1938. Pp. viii + 278. 7¼ × 4⅝ inches. $4.00.

BENNETT, MARY A. Metabolism of sulphur. V. The replaceability of *l*-cystine in the diets of rats with some partially oxidized derivatives. *Biochemical Journal,* Vol. 31, pp. 962-965, 1937. [Bibliography of 8 titles.]

BODANSKY, MEYER. Introduction to Physiological Chemistry. Fourth Edition. *New York* (John Wiley and Sons); *London* (Chapman and Hall), 1938. Pp. ix + 686. 9 × 5⅞ inches. $4.00. [Bibliographic footnotes throughout.]

BODANSKY, MEYER, and MARION FAY. Laboratory Manual of Physiological Chemistry. Fourth Edition. *New York* (John Wiley and Sons, Inc.); *London* (Chapman and Hall), 1938. Pp. vii + 295. 9 × 5¾ inches. $2.00

COOK, J. W., and E. L. KENNAWAY. Chemical compounds as carcinogenic agents. First supplementary report: literature of 1937. *American Journal of Cancer,* Vol. 33, pp. 50-97, 1938. [Bibliography of 180 titles.]

COOPER, E. A., and S. D. NICHOLAS. Aids to Biochemistry. Second Edition. *Baltimore* (William Wood and Co.), 1938. Pp. vii + 213. 6¼ × 3⅞ inches. $1.50.

GORTNER, Ross A. Outlines of Biochemistry. The Organic Chemistry and the Physicochemical Reactions of Biologically Important Compounds and Systems. Second Edition. *New York* (John Wiley and Sons); *London* (Chapman and Hall), 1938. Pp. xx + 1017. 9 × 6 inches. $6.00. [Bibliographic footnotes throughout.]

GREGORY, JENNIE. ABC of the Vitamins. A Survey in Charts. Foreword by Walter H. Eddy. *Baltimore* (Williams and Wilkins Co.), 1938. Pp. xii + 93. 11½ × 9 inches. $3.00. [Bibliography of 74 titles.]

HALDANE, J. B. S. The Chemistry of the Individual: Being the Thirty-eighth Robert Boyle Lecture Delivered before the Oxford University Junior Scientific Club on June 12, 1936. *New York* (Oxford University Press), 1938. Pp. 17. 8½ × 5½ inches. 40 cents (paper).

HAMMETT, FREDERICK S. The rôle of the amino acids in developmental growth and its possible significance in the cancer problem. *Occasional Publications of the American Association for the Advancement of Science,* No. 4, pp. 167-172. 1937.

HAMMETT, FREDERICK S. l-Hydroxyproline in developmental growth. *Growth,* Vol. 1, pp. 291-298, 1937. [Bibliography of 20 titles.]

HAMMETT, FREDERICK S. Developmental growth and nucleic acid components. VI. Adenine. *Growth*, Vol. 2, pp. 55-62, 1938. [Bibliography of 30 titles.]

HAMMETT, FREDERICK S. Pyrrolidone: a chemical group of particular significance to differentiation. *Nature*, Vol. 141, pp. 82-83, 1938. [Bibliography of 5 titles.]

HAMMETT, FREDERICK S., and WILLIAM D. COLLINGS. Developmental growth and l-proline. *Growth*, Vol. 1, pp. 285-290, 1937. [Bibliography of 16 titles.]

HAMMETT, FREDERICK S., THEODORE F. LAVINE, and MARIANNE LAVINE. Developmental growth and nucleic acid components—V. Cytosine. *Growth*, Vol. 1, pp. 189-193, 1937. [Bibliography of 16 titles.]

HAMMETT, FREDERICK S., and MARGARET R. PORTER. Developmental growth and nucleic acid components—VIII. Xanthine. *Growth*, Vol. 2, pp. 71-80, 1938. [Bibliography of 25 titles.]

HAMMETT, FREDERICK S., and THEA STEELE. Developmental growth and nucleic acid components. VII. Hypoxanthine. *Growth*, Vol. 2, pp. 63-70, 1938. [Bibliography of 21 titles.]

HARROW, BENJAMIN. Biochemistry for Medical, Dental and College Students. *Philadelphia and London* (W. B. Saunders Co.), 1938. Pp. 383. 9¼ × 6 inches. $3.75. [Bibliography of 18 titles.]

HAUROWITZ, FELIX. Fortschritte der Biochemie. III Teil (1931-1938). *Dresden and Leipzig* (Verlag von Theodor Steinkopff), 1938. Pp. xi + 167. 8¾ × 6 inches. RM. 9. (paper); RM. 9.75 (cloth). [Bibliographic footnotes throughout.]

KRAFFT, C. F. The Chemical Organization of Living Matter. *Washington, D. C.* (C. F. Krafft, 2510 Q Street, N.W.), 1938. Pp. 27. 9 × 6 inches.

LEPESCHKIN, W. W. Kolloidchemie des Protoplasmas. Zweite, erweiterte und vollständig umgearbeitete Auflage. *Dresden and Leipzig* (Verlag von Theodor Steinkopff), 1938. Pp. xii + 244. 8¾ × 6 inches. RM. 18. (paper); RM. 19. (cloth). [Bibliographic footnotes throughout.]

LUCK, JAMES M., and CARL R. NOLLER [Editors]. Annual Review of Biochemistry. Volume VII. *Stanford University P.O., Calif.* (Annual Review of Biochemistry), 1938. Pp. ix + 571. 8¾ × 6 inches. $5.00. [Bibliography of 2 pages.]

MEDES, GRACE. Metabolism of sulphur. VI. Oxidation in the body of the sulphur-containing amino-acids and some of their partially oxidized derivatives. *Biochemical Journal*, Vol. 31, pp. 1330-1346, 1937. [Bibliography of 22 titles.]

SOBOTKA, HARRY. The Chemistry of the Sterids. *Baltimore* (Williams and Wilkins Co.), 1938. Pp. xiii + 634. 8⅞ × 5⅞ inches. $8.50. [Bibliography of 62 pages.]

TOENNIES, GERRIT. Relations of thiourea, cysteine, and the corresponding disulfides. *Journal of Biological Chemistry*, Vol. 120, pp. 297-313, 1937. [Bibliography of 25 titles.]

TOENNIES, GERRIT. The sulfur containing amino acid methionine. *Growth*, Vol. 1, pp. 337-370, 1937. [Bibliography of 5¼ pages.]

TOENNIES, GERRIT. Oxidation of cysteine in non-aqueous media. The "sulfenic acid" as the primary oxidation product. *Journal of Biological Chemistry*, Vol. 122, pp. 27-47, 1937. [Bibliography of 25 titles.]

VIEHOEVER, ARNO, and SAMUEL C. PRUSKY. Biochemistry of silica. *American Journal of Pharmacy,* March, 1938, pp. 99-120. [Bibliography of 20 titles.]

VILLEGAS, VALENTE, L. A. YNALVES, and A. M. GATAN. A comparative study of the nutritive value of the carcasses of sheep and goats. *Philippine Agriculturist,* Vol. 27, pp. 52-58, 1938. [3 bibliographic footnotes.]

WILLIAMS, ROBERT R., and TOM D. SPIES. Vitamin B_1 (Thiamin) and its Use in Medicine. *New York* (The Macmillan Co.), 1938. Pp. xvi + 411. 9¼ × 6 inches. $5.00. [Bibliographies at the end of each chapter.]

4. *Pharmacology*

COFFER, Hon. JOHN M. An investigation of the narcotic evil. *Speech delivered in the House of Representatives,* June 14, 1938. *Washington* (Government Printing Office), 1938. Pp. 11.

YOUNKEN, HEBER W. A College Textbook of Pharmaceutical Botany. Sixth Edition. *Philadelphia* (P. Blakiston's Son and Co.), 1938. Pp. xxviii + 793. 9 × 6 inches. $4.75. [Bibliography of 7 pages.]

VI. PATHOLOGY, CLINICAL MEDICINE AND SURGERY

ADAIR, F. L. [Editor]. Prepared by R. D. MUSSEY, P. F. WILLIAMS, and F. H. FALLS. Maternal Care Complications. The Principles of Management of Some Serious Complications Arising during Antepartum, Intrapartum, and Postpartum Periods. Approved by the American Committee on Maternal Welfare, Inc. *Chicago* (University of Chicago Press), 1938. Pp. vii + 95. 7⅝ × 5⅛ inches. $1.00.

BUCHANAN, SCOTT. The Doctrine of Signatures. A Defence of Theory in Medicine. *New York* (Harcourt, Brace and Co.); *London* (Kegan Paul, Trench, Trubner and Co.), 1938. Pp. xvi + 205. 8½ × 5½ inches. $2.75.

CHRAPOWICKI, MARYLA DE. Spectro-Biology. *London* (C. W. Daniel Co.), 1938. Pp. 5 + 62. 8¾ × 5 inches. 3s. 6d. net.

FRETS, G. P. De tuberculose in de gestichten. Klinische diagnose en postmortem bevindingen. *Psychiatrische en Neurologische Bladen,* Jaargang 1937, No. 6. Pp. (of reprint) 12.

GRAY, H. Sacro-iliac joint pain. III. Etiology, diagnosis and treatment by manipulation. *International Clinics,* Vol. 2, Ser. 48, pp. 77-96 + 4 plates, 1938. [Bibliography of 4½ pages.]

HEGNER, ROBERT, FRANCIS M. ROOT, DONALD L. AUGUSTINE, and CLAY G. HUFF. Parasitology. With Special Reference to Man and Domesticated Animals. *New York and London* (D. Appleton-Century Co.), 1938. Pp. xxi + 812. 8¾ × 6 inches. $7.00. [Bibliography of 79 pages.]

JORDAN, EDWIN C. A Textbook of General Bacteriology. Twelfth Edition. Revised by William Burrows. *Philadelphia and London* (W. B. Saunders Co.), 1938. Pp. 808. 9⅛ × 5⅝ inches. $6.00. [Bibliographic footnotes.]

LOEPER, MAURICE, *et al.* Intoxications et Carences Alimentaires. *Paris* (Masson et Cie), 1938. Pp. viii + 259. 9¾ × 6¾ inches. 60 francs (paper). [Bibliography at the end of some chapters.]

McCarthy, Joseph F. The surgery of the prostate, open and closed, with especial reference to technic. *New England Journal of Medicine*, Vol. 217, pp. 57-63, 1937.

McCarthy, Joseph F. The internist looks at the prostate gland. *Journal of the Mount Sinai Hospital*, Vol. 4, pp. 763-770, 1938.

Partridge, William. Aids to Bacteriology. Sixth Edition. Revised by H. W. Scott-Wilson. *Baltimore* (William Wood and Co.), 1938. Pp. vii + 300. 6¼ × 3⅞ inches. $1.50.

Reimann, Stanley P. New facts in cancer. *Read at St. Louis*, February 20, 1936. Pp. (of reprint) 4.

Reimann, Stanley P. Cancer research considers diet. *Read at a meeting of the Dietitians Association of Philadelphia at The Lankenau Hospital Research Institute*, January 12, 1937. Pp. (of reprint) 4.

Rice, Thurman B. A Textbook of Bacteriology. Second Edition, Revised. *Philadelphia and London* (W. B. Saunders Co.), 1938. Pp. 563. 9⅛ × 5¾ inches. $5.00.

Simpson, S. Levy. Major Endocrine Disorders. *London* (John Bale Medical Publications), 1938. Pp. x + 184. 7¼ × 4¾ inches. 10s. 6d.

Vassiliadis, Homère, and Jean Steenhoudt. Contribution à l'étude du sang des cancéreux: vitesse de sédimentation, cholestérinémie et protéinémie. *Revue Belge des Sciences Médicales*, Année 9, pp. 633-640, 1937.

Waterman, N. Diet and Cancer: An Experimental Study. *Amsterdam* (D. B. Centen's Uitgevers-Maatschappij), 1938. Pp. 96. 9½ × 6¼ inches. Fl. 4.25 ($2.50). [Bibliography of 82 titles.]

Whipple, Dorothy V., and Ethel C. Dunham. Congenital syphilis. Part I. Incidence, transmission, and diagnosis. *Journal of Pediatrics*, Vol. 12, pp. 386-398, 1938. [Bibliography of 64 titles.]

Whipple, Dorothy V., and Ethel C. Dunham. Congenital syphilis. Part II. Prevention and treatment. *Journal of Pediatrics*, Vol. 13, pp. 101-119, 1938. [Bibliography of 112 titles.]

VII. METHODOLOGY

1. *Mensurational and Observational*

Lenzen, Victor F. Procedures of Empirical Science. *International Encyclopedia of Unified Science*, Vol. 1, Number 5. *Chicago* (University of Chicago Press), 1938. Pp. vii + 59. 9¾ × 6¾ inches. $1.00 (paper). [Bibliography of 26 titles.]

Nicholas, J. S. Biological photographic illustration. *Journal of the Biological Photographic Association*, Vol. 5, pp. 3-13, 1936.

2. *Mathematical and Statistical*

Bliss, C. I. The determination of the dosage-mortality curve from small numbers. *Quarterly Journal of Pharmacy and Pharmacology*, Vol. 11, pp. 192-216, 1938. [Bibliography of 5 titles.]

Brandt, A. E. Tests of Significance in Reversal or Switchback Trials. *Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic*

Arts. Statistical Section. Research Bulletin 234. *Ames, Iowa,* June, 1938. Pp. 57-87. 8¾ × 5¾ inches. [Bibliography of 7 titles.]

COMRIE, L. J., G. B. HEY, and H. G. HUDSON. Application of Hollerith equipment to an agricultural investigation. *Supplement to the Journal of the Royal Statistical Society,* Vol. 4, pp. 210-224, 1937.

DAVID, F. N. Tables of the Ordinates and Probability Integral of the Distribution of the Correlation Coefficient in Small Samples. *London* (Biometrika office, University College), 1938. Pp. xxxviii + [6] + 55 + 2 charts. 10⅞ × 8½ inches. 10s.

FORESTER, H. C. Design of Agronomic Experiments for Plots Differentiated in Fertility by Past Treatments. *Agricultural Experiment Station. Iowa State College of Agriculture and Mechanic Arts. Agronomy and Statistical Sections. Research Bulletin* 226. *Ames, Iowa,* November, 1937. Pp. 137-172. [Bibliography of 17 titles.]

GUMBEL, E. J. Gli eventi compatibili. *Giornale dell' Instituto Italiano degli Attuari,* Anno 9, N. 1, pp. 1-38, 1938. [Bibliographic footnotes.]

KOSTITZIN, V. A. Équations différentielles générales du problème de sélection naturelle. *C. r. des Séances de l'Académie des Sciences, Paris,* T. 206, pp. 570-572, 1938. [3 bibliographic footnotes.]

KOSTITZIN, V. A. Sur les points singuliers des équations différentielles du problème de la sélection naturelle. *C. r. des Séances de l'Académie des Sciences, Paris,* T. 206, pp. 976-978, 1938. [4 bibliographic footnotes.]

KOSTITZIN, V. A. Sur les équations différentielles du probème de la seléction naturelle dans le cas de mutation d'un chromosome sexual. *C. r. des Séances de l'Académie des Sciences, Paris,* T. 206, pp. 1273-1275, 1938. [4 bibliographic footnotes.]

NEYMAN, J. Contribution to the theory of sampling human populations. *Journal of the American Statistical Association,* Vol. 33, pp. 101-116, 1938. [4 bibliographic footnotes.]

STEVENS, W. L. The distribution of entries in a contingency table with fixed marginal totals. *Annals of Eugenics,* Vol. 8, Part III, pp. 238-244, 1938.

TAMAGNINI, EUSÉBIO. A heterogeneidade da variação. Análise da variância. Questões de método II. *Revista da Faculdade de Ciências da Universidade de Coimbra,* Vol. 6, No. 4. Pp. (of reprint) 19. [3 bibliographic footnotes.]

WAUGH, ALBERT E. Laboratory Manual and Problems for Elements of Statistical Method. *New York and London* (McGraw-Hill Book Co.), 1938. Pp. x + 171. 9 × 6 inches. $1.50. [Bibliographic footnotes.]

WISHART, JOHN. Field experiments of factorial design. *Journal of Agricultural Science,* Vol. 28, pp. 299-306, 1938. [Bibliography of 8 titles.]

YULE, G. UDNY. On some properties of normal distributions, univariate and bivariate, based on sums of squares of frequencies. *Biometrika,* Vol. 30, Parts I and II, pp. 1-10, 1938.

3. *Other and General*

BERKSON, JOSEPH. A tabular outline for use in reporting hospital morbidity. *American Journal of Public Health,* Vol. 28, pp. 723-729, 1938. [Bibliography of 4 titles.]

LEHMANN, ERNST, and OTTO MARTIN [Editors]. Deutsches Biologen-Handbuch. Eine Übersicht über die deutschen Biologen, die biologischen Institute und Organisationen. 2. Auflage. *München and Berlin* (J. F. Lehmanns Verlag), 1938. Pp. viii + 261. 8⅛ × 5⅝ inches. RM. 8; for members of the Deutscher Biologen-Verband, RM. 7.

MOLINARI, A. Institutions statistiques dont l'organisation relève de la décentralisation horizontale. Groupe de langues latines. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 26.

RICE, STUART A., and RICHARD O. LANG. The organization of statistical services in the United States of America and Great Britain. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 19.

TINKER, MILES A., and KENNETH H. BAKER. Introduction to Methods in Experimental Psychology. *New York and London* (D. Appleton-Century Co.), 1938. Pp. vii + 222 + 4 plates. 10¾ × 8¼ inches. $2.75. [Bibliography at the end of each chapter.]

WINKLER, W. Organisation der statistischen Ämter. Teilbericht über die Staaten mit teilweiser Zentralisation. XXIV^e *Session de l'Institut International de Statistique, Prague,* 1938. Pp. (of reprint) 24.

VIII. GENERAL AND MISCELLANEOUS

LEVY, H. A Philosophy for a Modern Man. *London* (Victor Gollancz), 1938. Pp. 287. 7¼ × 5 inches. 7s. 6d. net.

LUYET, BASILE J., [Editor]. Biodynamica. A Scientific Journal for the Elaboration and the Experimental Study of Working Hypotheses on the Nature of Life. Volume I. *Normandy, Mo.* (Biodynamica), 1934-1938. Pp. iv + 392. 9⅞ × 6⅞ inches. $6.00 per volume. [Bibliographies at the end of some of the articles.]

MACFAYDEN, MARY. Beauty Plus. The Smart Woman's Key to Beauty, Health and Charm. Illustrated by Frank N. Netter. *New York* (Emerson Books), 1938. Pp. 272. 8⅛ × 5½ inches. $1.96.

MORRIS, CHARLES W. Foundations of the Theory of Signs. International Encyclopedia of Unified Science. Volumes I and II: Foundations of the Unity of Science, Volume I, Number 2. *Chicago* (University of Chicago Press), 1938. Pp. vii + 59. 9½ × 6½ inches. $1.00 (paper). [Bibliography of 21 titles.]

NEURATH, OTTO [Editor]. Encyclopedia and Unified Science. International Encyclopedia of Unified Science, Volumes I and II: Foundations of the Unity of Science, Volume I, Number 1. Containing the following articles: Unified Science as Encyclopedic Integration, by Otto Neurath; Analysis and Synthesis in Science, by Niels Bohr; Unity of Science as a Social Problem, by John Dewey; On the Importance of Logical Form, by Bertrand Russell; Logical Foundations of the Unity of Science, by Rudolf Carnap; Scientific Empiricism, by Charles W. Morris. *Chicago* (University of Chicago Press), 1938. Pp. viii + 75. 9½ × 6½ inches. $1.00 (paper). [Bibliographies at the end of papers by Neurath, Carnap and Morris.]

WATKEYS, C. W. [Editor], H. A. ALLING, W. BERRY, R. G. DAGGS, F. W. FAIRBANKS, R. W. HELMKAMP, J. E. HOFFMEISTER, C. STERN, R. P. TITTSLER, and W. E. VAN DE WALLE. An Orientation in Science. First Edition. *New York and London* (McGraw-Hill Book Co.), 1938. Pp. x + 560. 9 × 5¾ inches. $3.50. [Bibliographic footnotes and "References" at the end of each chapter.]

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